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13. Finally, with the permission of the Editorial Board, papers processed through this system will be accepted for publishing in the KJMS, and they will be published online on the KDU journal website, followed by printed versions.

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STRUCTURAL ROBUSTNESS OF LIFE SATISFACTION SCALE OF PRE-SERVICE TEACHERS IN NIGERIA

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ABSTRACT

This paper investigated the structural robustness of the Life Satisfaction Scale (LSS) among Nigerian Pre-service Teachers. The study anchors on scale development research type of non-experimental design. Participants were selected randomly, totaling 509. The adopted instrument titled satisfaction with life scale with content validity index of 0.84 and ordinal alpha reliability of (α=0.75) aided in gathering data for the study. Obtained data were analysed using Exploratory Factor Analysis (EFA), Confirmatory Factor Analysis (CFA), and concurrent validity (that is equating with Rosenberg Self Esteem scale), respectively. The results showed that a single trait was evident in the scale, with Eigenvalues of 2.41, 0.97, 0.64, 0.53, and 0.44. Also, the CFA indicated a good fit to the data with compliance indices. A significant positive correlation of the LSS with the Rosenberg self-esteem scale (r=0.83, P<0.05) indicated acceptable concurrent validity. Similarly, LSS maintains its strict invariance regarding gender. The authors concluded that there was psychometric confirmation for a unitary structure of LSS in Nigeria, and since the two scales produced high correlations, the validity of LSS is referred to as concurrent. Therefore, it was recommended that LSS be used to complement scales that emphasise emotional well-being since it accesses an individual's conscious evaluative judgment of his or her life using personal criteria.

KEYWORDS*: Confirmatory Factor Analysis; Exploratory Factor Analysis; Life Satisfaction Scale; Ordinal Alpha; Rosenberg Self-Esteem Scale*

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1. INTRODUCTION

In life, individual values vary from one person to another. What is important to one may not be important to another because what satisfies individuals vary widely. Life Satisfaction Scale (LSS) was originally developed by Diener, Emmons, Larsen, and Griffin (1985) to measure individual satisfaction with life in total. Many researchers have overwhelmingly used it. The scale does not measure satisfaction with life domains such as health or finances but allows respondents to integrate and weigh this domain in any way they choose (Pavot & Diener, 2008).

Various methods of a quantitative assessment of structural robustness have been proposed and widely discussed in recent years (Wolinski, 2013). Robustness can have different meanings in different fields of science and technology, including assessment of the system, probabilistic investigation, mathematical modelling, software development, products, and procedures. Generally, robustness is the property of a considered system that enables it to survive unforeseen or extraordinary exposures or circumstances that would otherwise cause them to fail or to lose function (Wolinski, 2013). The structural robustness of LSS in this context means that the scale can handle variability and remain effective. LSS retains its adequate reliability, factor structure, acceptable concurrent validity gender invariant with previous studies.

A lot of studies on gender invariances reported as; strict invariance in Norwegian youth and adults (Clench-Aas, Nes, Dalgard & Aarø, 2011), Taiwanese undergraduates (Wu and Yao, 2006), British (Shevlin, Brunsden & Miles, 1998), Malaysian adults (Swami & Chamorro-Premuzic, 2009) and Chinese adults (Bai, Wu, Zheng, & Ren, 2011 cited in Esnaola, Benito, Antonio-Agirre, Freeman & Sarasa, 2017). Other researches have shown metric invariance in Norwegian adolescents (Moksnes, Løhre, Byrn, & Haugan, 2014) and scalar invariance in Swedish undergraduates (Hultell & Gustavson, 2008).

Many researchers have used variables like education, employment, economic status to examine the impact of life satisfaction (Diener & Chan, 2011; Oishi, Diener, Lucas & Suh, 2009; Pavot & Diener, 2008). According to Pavot and Diener (1993) cited in Lopez-Ortega, Torress-Castro & Rosas-Carrasco (2016), life satisfaction refers to a judgmental process in which individuals measure their quality of life based on their own set of unique standards. Psychometric attributes of LSS has been investigated among various populations (Morrison, Tay & Diener, 2011; Aishvarya, Maniam, Karuthan, Sidi, Jaafar & Oei, 2014) and in divergent cultures and nations of the world Spanish (Vázquez, Duque & Hervás, 2013), Mexican (Lopez-Ortega, Torress-Castro & Rosas-Carrasco, 2016). Portuguese (Sancho, Galiana, Gutierrez, Francisco, & Tomas 2014), French (Blais, Vallerand, Pelletier, Briere (1989), Turkish (Durak, Senol-Durak, Gencoz (2010), Chinese (Bai, Wu, Zheng, & Ren, 2011) and Dutch (Arrindell, Meeuwesen, & Huyse (1991).

Subsequently, the LSS has been found to represent a single construct (Lopez-Ortega et al., 2016; Atienza, Pons, Balaguer & GarcíaRMerita, 2000; Saman, Azadeh, Reza, & Zahra, 2016). Many investigations have shown that its structural integrity is unquestionable. Different types of validities are the Criterion-related validity (Schimmack, Oishi, Furr, & Funder, 2004; Saman et al., 2016), Factorial validity (Diener et al., 1985; Saman et al., 2016), Reliability, and its homogeneity (Saman et al., 2016; Lopez-Ortega et al., 2016). Some of these researches have reported item number five on the scale to have recorded poor factor loading compared to the rest of the items (e.g., Pavot & Diener, 1993; Vásquez et al., 2013). Pavot and Diener (1993) said that the item attends to the past adaptation against the present adaptation compared to the remaining four items. In their study, they observed that LSS had higher correlation with the present ($r = .92$) compared to past ($r = .72$) and future ($r = .59$) time plan. Previous studies have also examined the convergent, concurrent, and divergent validity of the scale and demonstrated suitable correlations with other measures of life satisfaction (Galanakis, Lakioti,

Pezirkianidis, Karakasidou & Stalikas, 2017; Pavot & Diener, 1993; Pavot, Diener, Colvin & Sandvik, 1991).

Lopez-Ortega et al. (2016) investigated psychometric properties of the satisfaction with life scale with samples from the 2012 Mexican and Healthy Aging Study. The participants' ages are from 50 years and above. The study revealed adequate reliability and construct validity of the Satisfaction With Life Scale (SWLS) in the Mexican context. The study centred on adults of 50 years and above in Mexico and not pre-service teachers in Nigeria.

Maria, Sousa[a], Santos[a], & Sobreira (2015) evaluated construct validity and psychometric properties of the Satisfaction With Life Scale (SWLS) in the Brazilian context. The study sampled 101 individuals from the general population with ages from 18 to 94 years. Results indicated a single factor structure and satisfactory internal consistency. The study conducted in Brazil contained all participants from Brazil. To the best of the researchers' knowledge, this has not been examined within the context of Nigeria.

Akinboboye, Akande, Jimoh & Adewuni (2016) examined the psychometric properties of the Rosenberg Self Esteem Scale (RSES) among pre-service teachers in Nigeria to measure the RSES internal consistency, and three reliability measures were used, namely: Cronbach Alpha (0.473), Guttman coefficient (0.506) and Speraman Brown (0.468). Factor analysis revealed one factor with eigenvalue greater than two accounted for 16.684% of the variance in test scores. The result revealed that RSES has a unitary factor structure. The study was carried out among Nigerian pre-service teachers using the RSES instrument, not the LSS instrument.

Also, Cronbach alpha, which has been criticised in the literature (Cronbach, 2004;1951) for its spurious estimation, was used in the previous studies to establish reliability. In this study, ordinal alpha for estimating reliability with the ordinal nature of the dataset was used (Gadermann, Guhn, & Zumbo, 2012).

Lastly, Musaitif (2018) investigated the psychometric properties of the Satisfaction With Life Scale among Arab Americans and found the instrument's strong validity. This study was conducted in America among Arabian, not pre-service teachers in Nigeria.

Although some of the authors in the empirical literature reviewed for this study focused on the structural robustness of LSS, no such study has been done among Nigerian pre-service teachers. Therefore, the purpose of this study was to assess the structural robustness of the Life Satisfaction Scale (LSS) among Nigerian pre-service teachers. Currently, the structural robustness of LSS and its applications among the Nigerian youth are undisclosed. Specific objectives of the study were to substantiate the internal consistency, to determine the factorial structure and concurrent validity and also to know if gender significantly influences the responses of LSS items among Nigerian pre-service teachers.

Research questions for this study were four-fold. These include; Do the items in LSS have a measure of internal consistency? What is the dimensionality of LSS among Nigerian pre-service teachers? Do the items in the two scales (LSS and RSES) establish concurrent validity among Nigerian pre-service teachers? Does gender have a significant influence on the responses of LSS items?

2. METHODOLOGY

The study is anchored on a scale development research type of non-experimental design. The population for the study consisted of all pre-service teachers (student teachers) in Federal Capital Territory (FCT) College of Education, Zuba, Abuja. The total population of the students was 6,345. The college has 29 departments (Psychology, Curriculum, Educational Foundation, General Studies in English, Early Childhood Care Education, Primary Education Studies, Christian Religious Studies, Islamic Studies, Economics, Geography, Social Studies, History, English Language, French, Arabic, Hausa, Igbo, Yoruba, Biology, Computer, Mathematics, Physics,

Chemistry, Integrated Science, Physical and Health Education, Agricultural Science, Home-Economics, Business Education and Fine Arts) in which 21 students from each of the 25 departments were randomly selected through lottery method of simple random sampling technique to make a total of 525 students, but only 509 of them returned the questionnaires and participated in the study. The remaining four departments (Psychology, Curriculum, Educational Foundation, and General Studies in English) were excluded because they took courses from them. The researchers used the sample size table provided by Krejcie & Morgan (1970) to guide sample size selection. 224 males represented (44%) with a mean age of 23.4 years and 285 females represented 54% with a mean age of 22.3 years. The instruments used for data collection were Life Satisfaction Scale (Diener et al., 1985) and Rosenberg Self-esteem Scale (RSES; Rosenberg, 1965).

Life Satisfaction Scale: The Life Satisfaction Scale (LSS) is an instrument that measures the cognitive aspect of subjective wellbeing. It comprised of five items measured on 7-point Likert response format. The five statement items are: in most ways, my life is close to my ideal, the conditions of my life are excellent, I am satisfied with life, I have gotten the important things I want in life, and If I could live my life over, I would change almost nothing.

Rosenberg developed Rosenberg Self Esteem Scale (RSES), 1965 cited in Akinboboye et al. (2016) to appraise self-esteem in adolescents and children. The scale has 10 items with a 4-point Likert type (i.e., Strongly Agree, Agree, Disagree, Strongly Disagree). Five out of the ten items are negatively worded, and the remaining five are positively worded. The positively worded are: I feel that I am a person of worth, at least on an equal plane with others, I can do things as well as most other people, I take a positive attitude toward myself, I feel that I have many good qualities, On the whole, I am satisfied with myself. The negatively worded are: I feel that I do not have much to be proud of; all in all, I am inclined to feel that I am a failure, I wish I could have more respect for myself, and I certainly feel useless at times. To examine the structural robustness of LSS, first, the reliability of the scale was carried out through Ordinal alpha reliability. Second, Exploratory Factor Analysis was performed to determine the construct validity of the instrument. Preliminary data verification through Barlett's Test of Sphericity was conducted to ascertain the appropriateness of factor analysis. This helps to know if the items were correlated in the population.

Furthermore, Confirmatory Factor Analysis (CFA) was conducted to establish the goodness of fit of the identified single-factor model. Concurrent validity between LSS and RSES was established through Pearson Product Moment Correlation (PPMC). Lastly, a t-test analysis was conducted to determine the influence of gender on the responses of LSS items. All analyses were carried out using Lisrel Statistical Software version 8.80 and Statistical Package for Social Sciences (SPSS) version 20.

3. RESULTS

Research Question 1: *Do the items in LSS have a measure of internal consistency?*

Reliability of the Instrument

Answering this research question, Ordinal alpha reliability was conducted using R-programming language, and the coefficient for assessing internal consistency of the LSS was 0.75 (see Table 1 below). Ordinal Alpha Reliability Implemented in R Programming Language.

raw_alpha	std.alpha	G6(smc)	average_r	S/N	median_r
0.75	0.75	0.74	0.38	3.1	0.38

Table 1: Reliability if an item is dropped

Item	raw_ alpha	std. alpha	G6(smc)	average_r	S/N	var.r	med.r
1	0.71	0.71	0.68	0.38	2.5	0.023	0.37
2	0.68	0.68	0.64	0.35	2.1	0.0179	0.34
3	0.66	0.66	0.62	0.33	1.9	0.0204	0.34
4	0.7	0.7	0.67	0.37	2.3	0.0374	0.38
5	0.79	0.79	0.74	0.48	3.7	0.0075	0.49

Item statistics			
Item	R	r.cor	r.drop
1	0.71	0.61	0.52
2	0.77	0.71	0.6
3	0.8	0.76	0.66
4	0.73	0.62	0.55
5	0.54	0.35	0.3

From the findings of this study, the scale has an adequate level of reliability with an Ordinal alpha coefficient of 0.75.

Research Question 2: *What is the dimensionality of LSS?*

Exploratory Factor Analysis (EFA)

The preliminary analysis of Barlett's test of sphericity produced 525.068 at $p<0.05$ level of significance. This shows a high correlation among the items. Also, the Kaiser Meyer-Olkin index produced a 0.76 value which shows the appropriateness of the data for factor analysis. The EFA ensued in a single factor, explaining 48.28% of total variance with an eigenvalue of 2.414 (see Table 2)

Table 2: Eigen value and total variance explained of LSS

Total Variance Explained						
	Initial Eigenvalues			Extraction sums of squared loading		
Component	Total	% of variance	Cummu. %	Total	% of variance	Cummu. %
1	2.414	48.277	48.277	2.414	48.277	48.277
2	.968	19.368	67.646			
3	.642	12.844	80.490			
4	.534	10.684	91.174			
5	.441	8.826	100.000			

Extraction Method: Principal Component Analysis

A Scree plot was employed to represent the eigenvalues and the number of factors graphically. It is evident from the Scree plot that the single-factor model was appropriate to represent the data (see Figure 1).

Table 3: Factor Loadings of LSS

s/n	Item	Factor
1	In most ways my life is close to my ideal	.60
2	The conditions of my life are excellent	.73
3	I am satisfied with my life	.74
4	So far, I have gotten the important things I want in life	.55
5	If I could live my life over, I would change almost nothing	.30

It would be preferable if the first factor accounted for more variance. However, Wiberg (2004) stated that it is not uncommon to have this type of situation. As long as there is one factor with a distinctly larger eigenvalue, it is possible to assume the unitary dimension in the test. From Table 3, the items factor loading varies from .30 for item 5 to .74 for item 3.

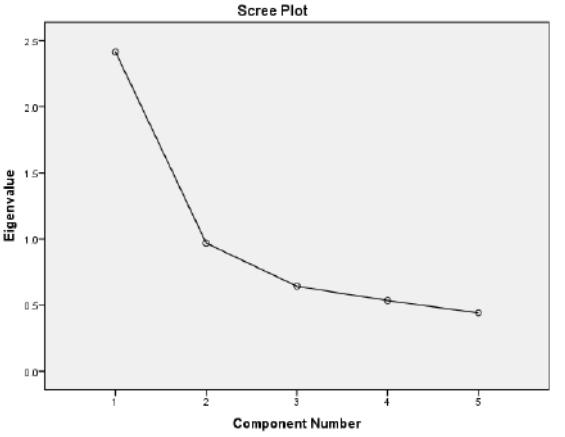


Figure 1: The scree plot (Cattell) of LSS

Confirmatory Factor Analysis

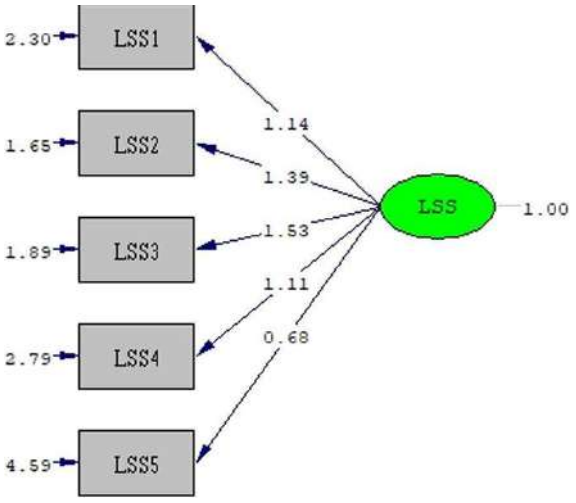
Confirmatory Factor Analysis (CFA) was conducted to establish the goodness of fit of the identified single-factor model. Table 4 below shows the values of the four most widely used goodness of fit indicators revealing a single-factor model that fits the scale. They are Normed Fit Index (NFI), Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), and Goodness of Fit Index (GFI) (Bentler & Bonett 1980; Tanaka & Huba, 1984; Steiger & Lind, 1980).

RMSEA is a measure of how a model fits a set of data. A zero value shows that the model fits the data absolutely; values less than .05 shows that the model indicates a good fit with the data; a value between .08 and .10 shows a mediocre fit, and values above .10 show a poor fit (Browne & Cudeck, 1993; MacCallum et al., 1996). CFI and NFI produce value ranges between 0 and 1 where high value shows a good fit. CFI value of 0.97 shows that the fit is better compared to the model (Schermelleh-Engel & Moosbrugger, 2003; Chen, 2007; Hu & Bentler, 1999).

Table 4: Goodness of fit indices that shows how a single factor model fit LSS

Scale	RMSEA	GFI	NFI	CFI
LSS	0.104	0.98	0.92	0.96

The standard factor loadings for the single-factor model are shown in figure 2. All factor loadings were significant and in the expected direction



Chi-Square=32.45, df=5, P-value=0.00000, RMSEA=0.104

Figure 2**:** Standard factor loadings for the single-factor model.

The model fit indices of LSS are shown in Figure 2. The five-item model of LSS demonstrated a good fit for the data. The LSS factor loadings were statistically significant and ranged from 0.68 to 1.53.

Research Question 3: *Do items in the two scales (LSS and RSES) establish concurrent validity among Nigerian pre-service teachers?*

In order to analyse the concurrent validity of the LSS, the Pearson product-moment correlation coefficient was calculated between LSS and RSES. The LSS was significantly positively correlated with RSES (R = 0.83, P<0.05), indicating acceptable concurrent validity.

Research Question 4: *Does gender have a significant influence on the responses of LSS items?* The responses of the male and female pre-service teachers were subjected to t-test analysis, and the results are shown in Table 5.

Table 5: t-test analysis of gender invariance in LSS items

Gender	N	Mean	df	t	sig
Male	224	23.03	507	-.808	.419
Female	285	23.53			

Table 5 showed no significant difference between male and female pre-service teachers in their responses to LSS items since t = -.808 and p>.05. This implies that LSS is gender invariant.

4. DISCUSSION

The LSS was aimed to measure the cognitive-judgmental dimension of subjective well-being. The main purpose of this study was to assess the structural robustness of the LSS among the Nigerian Pre-service teachers. The sample of 509 pre-service teachers was considered to assess the reliability, construct, and concurrent validity of the LSS. From the findings of this study, the scale has an adequate level of reliability with an Ordinal alpha coefficient of 0.75. This finding corroborated the findings of previous researchers like Galanakis et al., 2017; Saman et al., 2016; Lopez-Ortega et al., 2016. Their studies revealed adequate reliability and construct validity.

All LSS items presented higher factor loadings except Item 5 that displayed the weakest factor loading of .30. Following the explanation to justify this, Pavot and Diener (1993) said that the item attends to the past adaptation against the present adaptation compared to the remaining four items. In their study, they observed that LSS had a higher correlation with the present (r = .92) compared to past (r = .72) and future (r = .59) time plan. Moreover, the results from the study confirm the single-factor model of the scale buttressing the findings of the previous researchers (Diener et al., 1985; Atienza et al., 2000; Maria et al., 2014; Lopez-Ortega et al., 2016; Musaitif, 2018). In addition, the EFA also revealed a unique factor that explained 48.28% of the total variance. The outcomes of both CFA and EFA show that LSS has a unitary dimension among

Nigerian pre-service teachers.

The study outcomes revealed supplementary evidence for the construct of LSS, which positively correlated with RSES that corroborated previous findings (Galanakis et al. 2017; Pavot & Diener, 1993; Pavot et al. 1991).

Lastly, the study results showed that LSS is gender invariant since no significant difference exists between male and female pre-service teachers in their responses to LSS items. This finding supported the previous findings (Wu & Yao, 2006), British (Shevlin, Brunsden & Miles, 1998), Malaysian adults (Swami & Chamorro-Premuzic, 2009), and Chinese adults (Bai, Wu, Zheng, & Ren, 2011).

5. CONCLUSION

In conclusion, the study examined the structural robustness of LSS among 509 Nigerian pre-service teachers and showed adequate reliability, factor structure, and acceptable concurrent validity, in agreement with previous studies. The LSS has adequate structural robustness for assessing life satisfaction in Nigerian pre-service teachers and maintained gender invariance.

6. RECOMMENDATIONS

Researchers can use LSS to examine life satisfaction among adult youths in Nigeria and countries of comparable economic and cultural backgrounds. Furthermore, LSS can be used as a complement for scales that focus on emotional wellbeing since it accesses an individual's conscious evaluative judgment of their life using personal criteria. Despite the findings, this study possesses a few limitations. First, the study is limited to the population of students in a College of Education. Second, the study is limited to pre-service teachers (young adults) in Nigeria. Future studies can include populations from different higher institutions and adults above the age bracket used in this study.

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PRODUCER RESPONSIBILITY IN MANAGING PLASTIC PACKAGING WASTE IN SRI LANKA: A LEGAL FRAMEWORK BASED ON LESSONS LEARNED FROM GERMANY

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ABSTRACT

The life cycle of plastic packaging ends in polluting the environment and negatively impacting wildlife, marine life, and human health. In Sri Lanka, manufacturers and distributors are not responsible for the end life cycle of plastic packaging under our domestic legislation. In 1991, Germany was the first country to introduce the legislative implemented "Extended Producer Responsibility" to the rest of the world through the German Packaging Ordinance. In 2016, Germany's domestic recycling rate was "65 percent," making it the world's "leading race" country (Singapore Environmental Council, 2018). Because Sri Lanka is a developing country, this study examines the various disposal options for plastic packaging waste, realising that Germany has much to teach Sri Lanka. Due to the lacuna in national policy in managing post-consumer plastic packaging waste, this study intends to examine the applicability of legislatively implemented Extended Producer Responsibility (EPR) in Sri Lanka through the lessons learned from the German jurisdiction.

Additionally, this qualitative study examines how lessons from Germany can be incorporated into the legal framework in Sri Lanka to manage plastic packaging and packaging waste better. National Environmental Act, Special Regulations published in the gazette are given more attention and analysed and discussed accordingly in identifying the lacuna in Sri Lanka's Jurisdiction in managing the end life cycle of post-consumer plastic packaging waste. The recommendations based on the findings through the in-depth literature reviews in this research form an implementation plan for plastic packaging waste policies in the domestic jurisdiction highlighting the mandatory final disposal and recovery of plastic packaging by manufacturers and distributors in Sri Lanka to ensure sustainable business practices.

KEYWORDS: *Plastic Pollution, Plastic Packaging, Producer Responsibility*

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1. INTRODUCTION

Manufacturers can control and prevent Post-Consumer Plastic Packaging (P.C.P.P.) that goes into the private consumers' waste bin in the first place. As a result, less waste will end up in landfills, incinerators, and the environment as a whole. In several parts of Sri Lanka, residents burn P.C.P.P. waste due to the failure of local authorities in collecting plastic waste. Burning plastic releases harmful gases such as *dioxins* and *furans*, which cause lung diseases and cancer. Therefore, the prevention that requires "collective social awareness, waste knowledge, innovative manufacturing, and business models" (Cox et al., 2010) and "the principle of source reduction and implementation of such systems" (Zakowskav, 2008) is crucial in this regard. Van Sluisveld and Worrell (2013) highlighted that policies on packaging waste prevention are ineffective without packaging "source reduction."

Identifying the end life cycle of plastic packaging and producer responsibility was not crucial under legislative enactments towards better managing plastic waste in Sri Lanka. According to Xu and Gursoy (2015), only legally enacted E.P.R. regulations can ensure the producer's responsibility.

In 1991, Germany came up with the legislative "Extended Producer Responsibility" (E.P.R.) as a robust solution for the issues faced in waste management by making the manufacturers and distributors responsible for the final disposal of their products' packaging waste. A piece of legislation in Germany, the German Packaging Ordinance, was identified as the world's first E.P.R. law. The ordinance compels manufacturers and distributors to collect the packaging waste (Nakajima and Vanderburg, 2006). Following Germany, the European Union implemented the directive on plastic packaging among its member countries. (Bury, 2010).

This study identifies the prevailing laws governing plastic packaging waste in the Jurisdiction of Sri Lanka and Germany to analyse qualitatively and discuss whether statutes are adequate in solving the issues with the plastic packaging life cycle ending in the environment in Sri Lanka. Finally, this study suggested recommendations from the lessons learned from the German jurisdiction guaranteeing environmental, social, and economic performances. Hence, the findings of this study will focus on policymakers making decisions wisely when implementing regulations on plastic waste.

2. METHODOLOGY

This study is qualitative research with qualitative data gathering following primary sources such as statutes and case law from Sri Lankan and German Jurisdiction. The study descriptively analysed and discussed the relevant legislative provisions managing plastic packaging waste in Sri Lanka. Primary sources such as the National Environmental Act, Code of Criminal Procedure Act, Special Regulations gazette through gazette notifications are given special attention in this study. Secondary data for the study were collected from Government publications through websites such as those of the Ministry of Environment, Central Environment Authority, Western Province Waste Management Authority, and conference papers and scholarly journal articles.

The study identifies that legislatively implemented E.P.R. regulation underpins the system's efficacy in Germany. Therefore, the German Packaging Ordinance is one of the unique primary sources under the German jurisdiction in this study. As a result, the research descriptively analyses and discusses the German Packaging Ordinance. Further, the study examines and discusses Germany's implementation of E.P.R. through the German Packaging Ordinance. When researching the opportunities and challenges of Germany's packaging waste ordinance, researchers drew on secondary sources like books with analytical studies, scholarly journal articles and conference papers, and web resources of PRO Europe and Singapore Environmental Council.

The study qualitatively analyses and discusses the adequacy of legislative enactments in Sri Lanka on

PCPP waste with the lessons learned from Germany to the local situation. This research is based on the Doctrinal research method, also known as the "black letter" methodology, which is popular and most applicable in legal research studies. Therefore, the researchers emphasised the letter of the law rather than the law in practice in this study.

3. LITERATURE REVIEW

SWM has become an environmental, social, and political issue in Sri Lanka due to poor plastic waste management. SWM, a function of local Government, is mentioned explicitly in the statute. National, provincial, and municipal courts make up the country's legal system. Sections-129, 130, and 131 of Municipal Council Ordinance No.16 of 1947, Sections-118,119 and 120 of the Urban Councils Ordinance No.61 of 1939 and Sections-93, 94 and 95 of the Pradesheya Saba Act No.15 of 1987 stipulate that "providing suitable dumpsites" and "removal of non-industrial solid waste" are responsibilities of the Local Authorities (Municipal Councils-23, Urban Council-41, Pradeshiya Sabhas-271) (EFL, 2017).

Ministries of Local Government and Provincial Councils (M.L.G.P.C.), Mahaweli Development and Environment (M.D.E.), Megapolis and Western Province Development (M.D.P.D.C.); City of Colombo Urban Development Authority (C.U.D.A.), and the Western Province Waste Management Authority (W.P.W.M.A.) are all central government agencies. National Environmental Act (N.E.A.) No.47 of 1980 and its amendments are the predominant legal framework in "managing waste" in Sri Lanka. As defined by Section-33 of N.E.A. No.47 of 1980, waste is defined as "any matter prescribed to be waste," "whether liquid, solid, gaseous, or radioactive" and discharged into the environment in a volume, constituency, or manner that change. Consequently, the post-consumer plastic packaging meets the definition of waste under the National Environment Act. However, P.C.P.P. waste in our environment continues to grow unabated due to the legislative gap that exists.

Plastic Packaging Waste in Sri Lanka

During the years 2016-2018, Sri Lanka imported an estimated 289,218MT of plastic-related products. According to these estimates, plastic waste generation in 2020 would be 938.42MT/D, with 261.82MT/D dumped openly and 38.48MT/D recycled of the 300.30MT/D collected (Ministry of Environment, 2021).

Over half a million tons of uncollected trash is dumped directly into waterways every day. Another 139.82 million tons are self-disposed by consumers, and another 70 million tons are illegally dumped (Ministry of Environment, 2021).

Withanage (2019) stated that plastic packaging companies are "responsible for 90% of the single-use plastics and 50% of the total plastics worldwide and in Sri Lanka". This makes evident the inadequacy of the legislatively implemented E.P.R. towards P.C.P.P. waste under the domestic jurisdiction. Therefore, a mechanism towards the effective management of P.C.P.P. waste is vital in Sri Lanka.

Legal Framework for Plastic Waste in Sri Lanka

Provisions of Code of Criminal Procedure No.15 of 1979 and Public Nuisance Ordinance No.15 of 1862 deal with "waste management" and "disposal" (EFL, 2017). Special Regulation (S.R.) No.1627/19 made under Section-32(2)(h) of the N.E. Act No.47 of 1980 is on Municipal Solid Waste.

The use of polythene or any polythene product with a thickness of fewer than twenty microns is prohibited by S.R., No.2034/33. It is also prohibited from being sold, offered for sale, given away, exhibited, or used within the country under S.R., No.2034/33. It could be "Polythene, or any polythene, such as any of the following: Polypropylene (P.P.), Polyethylene, Polyethylene Terephthalate ("P.E.T."), or Poly Vinyl Chloride." Prior written approval of C.E.A. is needed to use products with a thickness of 20 microns or less."

Regulation has "permitted the use of the following

material for laminating purpose (a) P.E.T. regardless of whether metalised or holographic P.E.T. film; (b) P.P. films regardless of whether metalised or pearlised; (c) Nylon; (d) Cast Polypropylene (C.P.P.) or metalised Cast Polypropylene (C.P.P.); (e) P.V.C.; (f) Polyethylene Terephthalate Glycol (P.E.T.G.) use for medical or pharmaceutical purposes in the absence of any other suitable alternative" (S.R. No.2034/33). However, shrink-wrap, blister packaging, and plastic films as the top layer for cardboard packaging are neither authorised nor prohibited for use in Sri Lanka.

However, this regulation has failed to identify and prohibit the use of "unnecessary packaging" such as shrink-wrap and blister packaging. These are identified as unavoidable in product promotion, reducing decomposition, and protecting during transportation and storage. Because of this, it is possible to argue that product safety measures should not just focus on the packaging but also on how well the products are transported and stored. So long as this situation persists, the total amount of P.C.P.P. waste generated by and out of each package will rise at the end of its useful life.

S.R. No.2034/34 states that polythene food wrappers (lunch sheets) cannot be sold, offered for sale, given away, displayed, or used within the country. It also states that "manufacturing of food wrappers (lunch sheets) from polythene as a raw material for in-country use" is prohibited. This regulation has come into effect from 01 August 2021 while encouraging the sale of biodegradable lunch sheets in Sri Lanka.

S.R., No.2034/35 bans "manufacture of any bag of H.D.P.E. as a raw material for in-country use; and sale, offer for sale, offer free of charge, exhibition or use of any bag manufactured from H.D.P.E. as a raw material (bags of any dimension with or without handles to carry products or goods including grocery bags generally referred to as ''sili-sili bags" in local terms) within the country" (S.R., No.2034/35). Further, the regulation has exempted 'garbage bag of the following dimensions or above: Length-600mm Width-260mm Height-900mm and the textile bag of following dimensions or above Length-400mm Height-500mm". This regulation, however, does not entirely ban the items mentioned above.

National Environmental (Prohibition of open burning of refuse and other combustible matters inclusive of plastics) Regulations No.1 of 2017 implemented through Special Regulation No.2034/36. The regulation states that "no person shall burn openly or cause to allow or permit the open burning of refuse or other combustible matters inclusive of plastics," and offenders are punishable under Section-31 of the N.E. Act No. 47 of 1980. An awareness of the regulation is not popular among the citizen in Sri Lanka.

According to the researchers' findings, consumers are increasingly burning P.C.P.P. waste to get rid of it because local authorities do not do an excellent job of collecting it. Hence, it seems that the improper waste collection by local authorities negatively influences consumers to burn the P.C.P.P. waste. Therefore, it is vital to concentrate on the motive of the consumers who tend to burn the P.C.P.P. waste instead of handing the waste to the local authority waste collectors.

On the other hand, people in rural and suburban areas use plastic packaging waste as cooking fuel and wood. The word "openly" mentioned under Regulation No.2034/36 implies that an individual still may burn plastic waste. The regulation has created a loophole in plastic waste management as it impliedly discourages the recycling and recovery process for P.C.P.P. waste.

S.R., No.2034/37 has prohibited "all forms of P.E., P.P., PE products or P.P. products as decoration in political, social, religious, national, cultural or any other event or occasion." The regulation has an adequate capacity to eliminate one way of plastic pollution in the environment. However, one may argue by stating that the objective of this regulation is very much narrow. Therefore, the effectiveness and efficiency in overall plastic waste management throughout these implemented regulations are inadequate.

To make matters worse, under S.R., No.2034/38, it

was illegal to "manufacture for use in the country food containers, plates, cups and spoons made of expanded polystyrene; and to sell or offer for sale food containers (lunch boxes) made from expanded P.S. within the country." Even this regulation is vital to prohibiting single-use plastic items, and law enforcement is highly ineffective.

National Environmental (Plastic Material Identification Standards) Regulations No.1 of 2021 implemented Special Regulation No.2211/50. The regulation states, "any manufactured plastic item shall be marked clearly under the plastic material identification standards specified in the schedule" (S.R., No.2211/50). However, the regulation has failed to address the issue of distributors, who are equally responsible in Sri Lanka for P.C.P.P. waste. Because it only applies to the manufacturer, the regulation has ineffective managing plastic packaging waste in Sri Lanka. S.R., No.2211/51 has prohibited "the use of (a) P.E.T. or P.V.C. material for packaging agrochemical used for any process, trade or industry and (b) any plastic item (a product manufactured using P.E.T., H.D.P.E., LDPE, P.V.C., P.P., P.S., biodegradable plastic or any other similar raw material or any mixture thereof) specified herein for any process (manufacturing), trade (sale and offer for sale) or industry; (i) sachet having less than or having equal to a net volume of 20ml/ net weight of 20g (except for packaging food and medicine), (ii) inflatable toys (except balloons, balls, water floating/ pool toy and water port gear), (iii) Cotton buds with plastic stems (except plastic cotton buds used for medical/ clinical treatment)".

This regulation stipulates a vital step towards the management of plastic packaging waste. However, even though studies have shown that plastic straws harm marine life, such as sea turtles, there was no ban on using these straws. It is also critical to prohibit single-use plastic packaging, which will help cut down overall plastic waste.

A study by Karunarathne (2015) emphasises the necessity for a "national-level strategy" on S.W.M. The study highlighted that "provincial-level policies are inadequate" in catering to the local authorities. The study has highlighted that current legislation is concerned solely with "collection and disposal," prioritising the "landfills" instead of reusing and recovering the waste. The study has further pointed out that local authorities are incapable of handling "waste management plants due to lack of infrastructure facilities such as machinery, equipment, professional staff, and skilled labour."

Many studies, such as those (Karunarathne, 2015) (Basnayake, 2014) show that the lack of a national policy makes it difficult to manage plastic waste. Therefore, this study aims to fill the gap in the Jurisdiction of Sri Lanka, especially considering implementing national policy regarding plastic packaging on prevention, reduction, disposal, and sorting.

Plastic Packaging Waste in Germany

In 1991, Germany became the first country to pass a law addressing packaging waste. A legislated example of E.P.R. is the Packaging Ordinance (VerpackV). Durability, reusability, recovery, and separation of source material packaging were essential considerations in developing the ordinance. As a result, customers in Germany produce less packaging trash, which will eventually have a good influence on landfills and incineration. In the 1980s, Germany was facing waste management issues, such as those experienced in Sri Lanka today. '[O]ne such is lack of adequate capacities for landfilling' (Costa, Massard, and Agarwal, 2010) and excess beverage packaging use. The German packaging ordinance is based on Extended Producer Responsibility for the packaging and recovering at the end of its lifecycle.

In 2016, Germany's predicted domestic recycling was "65 percent," and the country declared as "winning the race in the globe" (Singapore Environmental Council, 2018). Once the recovery and recycling rates increase, the quantities of mismanaged plastic waste in landfills decrease. Figure 1 illustrates Eurostat data from 2015. As it indicates, in the countries with the highest recycling rates, the existence of landfills is lesser. On the other hand, the countries having more landfills are recycling lesser

quantities. Specifically, Figure 1 indicates that the landfills are significantly lesser in countries with the highest incineration treatments.

The consumers in Germany are facilitated by locating bins at places convenient for disposal. Private consumers received a "yellow bag" for putting their packaging waste for final collection by D.S.D. (Steven, 1995). This practice is identified as an effective mechanism as it inevitably segregates the plastic packaging waste from the residual waste. Afterward, D.S.D. will hand over the collected waste to a contracted company for waste recovery and then to a plant for material sorting. At the same time, D.S.D. will pay recyclers to return "sorted material." (PRO Europe, 2019). Žmak and Hartmann (2017) highlighted the effectiveness and efficiency of "Green Dot" together with the German dual recycling procedure. The Government has given the right to handle the business exclusively by imposing conditions for its operation. Conditions are to "offer national coverage, locate collection bins close to consumers, routine collection schedules, and integrate the collection plan with state and local systems" and to abide by the requirements of the Packaging Ordinance (PRO Europe, 2019).

As a result of this new scheme, every shop above "200 m^2 shop areas" are obliged to collect back drinking beverages sold of the same material." It seems that the retailer performs a role similar to the distributor in this instance. The customers receive rewards from supermarkets in exchange for returning bottles with refundable signatures. The study further finds that the "recycling rate of P.E.T. bottles with the deposit in Germany was 97.20% in 2017" (Žmak & Hartmann,2017).

Figure 1 shows that German recycling rates are higher among all other member states in the E.U., and landfills in Germany are significantly lower. Accordingly, the waste management laws of Germany were successful in achieving the goal of efficient and effective waste management.

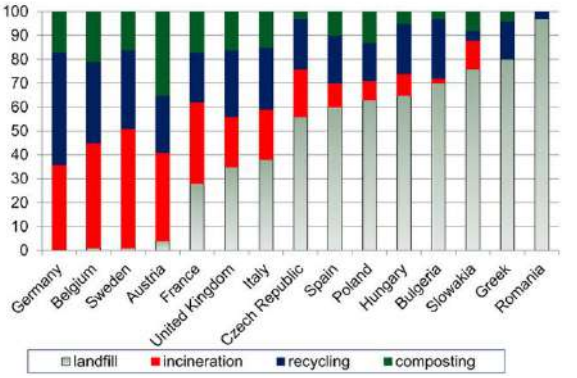

Figure 1. M.S.W. treatment in selected E.U. countries Source: Eurostat 2015 (Nelles, Grunes and Morscheck,2015)

The utilisation of recovered trash in Nelles, Grunes, and Morscheck's (2016) study said that enterprises in Germany currently utilize fourteen percent (14%) of recovered garbage as raw materials. The reason behind the use of quantities of recovered waste stipulates the success of the German regulation towards the manufacturers and distributors, or in other words, the capability of preserving the environment.

Clemens Stroetmann, State Secretary at the Federal Ministry for the Environment in Germany, stated that the government forces industries to be concerned about the final disposal of packaging waste "as a part of a product's life cycle." In contrast, the traditional perspective towards the product's life cycle focuses only on introduction, growth, maturity, and decline.

Reynolds (1995) pointed out that "the conventional cycle" is included in the final disposal of packaging trash, and "the Costs of Handling Packaging Wastes" is included in the total price of the product. As a result of free-market economics, the high cost ultimately passes on to the customer. Therefore, the product's final disposal has become an essential part of its life cycle.

Organisation for Economic Corporation and Development O.E.C.D. (1998) highlighted "mandatory control with time-based quotas for material reuse and recycling and requirement for mandatory return by retailers of waste packaging"

identifiable as essential requirements towards the success of German packaging ordinance (Nakajima and Vanderburg,2006). Therefore, not only the manufacturers and distributors but also the retailers are obliged under the ordinance. In achieving the targets, two out of the three "R" principles get highlighted.

As given below, Figure 2 shows the increase in recycling from 2003 up until 2014. This figure shows that once the recycling goals increase rapidly, the municipal waste quantities have reduced tremendously.

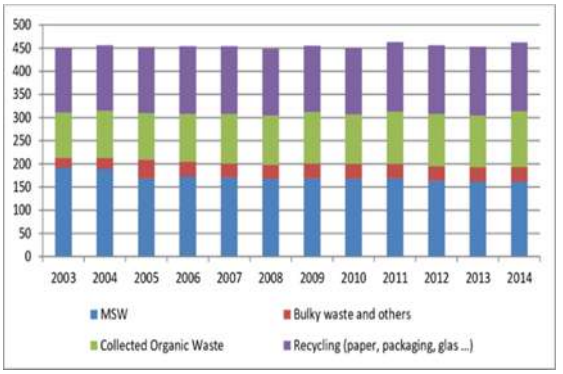

Figure 2. Waste arising in Germany (Nelles, Grunes, and Morscheck,2016). Source: BMU, 2015 (Nelles, Grunes and Morscheck, 2016)

Legal Framework for Packaging Waste in Germany

The study of Nakajima and Vanderburg (2006) declared that Germany had become the first country to set requisites for the "recovery and recycling of sales packaging." Further, the study highlighted that the German waste management policy is concerned with "Closed Cycles" product responsibility and final disposal unto manufacturer and distributor, and it has led to "awareness on separation of waste," "new disposal technologies," and "increased recycling capacities." Therefore, the E.P.R. and final disposal of packaging waste are deeply rooted in German jurisdiction, resulting in effective packaging waste management.

Article-1 of the Packaging Ordinance 1991 highlighted the packaging material as "environmentally acceptable and did not hinder recycling." The objective of this ordinance is to avoid and reduce the environmental impacts caused by packaging waste. Packaging should be reduced in "volume and weight" to better market and protect their contents. As a final suggestion, it suggests recycling any empty packaging when it is "technically possible and feasible." The researcher has identified that Article-1 of the ordinance stipulates the five "R" principles, Reduce, Reuse, Recycle, Recover and Refuse.

Table 1. Definitions	
"Packaging"	"Any material used to manufacture products to store or present goods (from raw materials to processed goods) that are passed on to the distributor or final consumer by the manufacturer. (Article-3)
"Sales packaging (Cups, bags, blister packaging, cans, bottles, cartons, sacks)."	"Packaging that is made available as a sales unit and arises at the final consumer. Sales packaging within the meaning of the ordinance shall also include such packaging provided by retailers, restaurants and other service providers as facilitates or supports the transfer of goods to the final consumer (service packaging) and disposable dishes and disposable cutlery". (Article-3)
"Manufacturer"	"Anyone who manufactures packaging-able goods is subject to this ordinance's requirements, as are those who import packaging into the jurisdiction in which it is in force. (Article-3)
"Distributor"	"Anyone who puts into circulation packaging, packaging materials or products from which packages directly manufactured, or goods in packaging, at whatever level of trade. Distributor within the meaning of this ordinance shall also include the mail-order trade". (Article-3)
"Final consumer"	"Anyone who does not further resell the goods in the form delivered to him." (Article-3)
"Private final consumers"	The use of standard household collection containers for paper and cardboard to remove waste is not

	limited to homes and similar places (like restaurants and hotels). There are numerous other places where waste is collected via these containers (like hospitals and educational institutions). The exceptions to this rule are printing works and other paper processing operations." (Article-3)

Source: Author created table (Article-3 of Packaging Ordinance 1991)

Article-5 mentions a requirement to accept returned secondary packaging. Because of secondary packaging, the article has brought attention to the distributor's duties. Retailers are required to accept returned sales packaging under the ordinance's Article-6. Article 7 states that "the obligation to accept returned sales packaging of pollutant-containing products" is in place for retailers. In this article, the packaging can be reused or recovered when "technically possible" and "economically reasonable." Article-8 of the ordinance states, "Obligation to charge deposits on drinks and detergents packaging and cleaners and of emulsion paints." Items that are not reusable will be subject to a deposit under the terms of this article.

According to Article 9, "protected from the obligation to charge deposits" is mentioned explicitly for environmentally friendly beverage packaging. There is a reference in this article to beer, wine, and pasteurised milk packaging for mineral water, carbonated soft drinks, fruit juice, and other noncarbonated soft drinks. Beer, mineral water, soda pop, fruit juice, and noncarbonated soft drinks are all listed in this article as being in the category of "beverage packaging." Article-10 states the "limitation of the obligation to accept returned packaging and to refund deposits." As per Article-11 of the ordinance, "manufacturers and distributors may call upon third parties to fulfill the obligations laid down in this ordinance." The article also mentions that "A machine may also perform acceptance of returned packaging and refunding of deposits." are both possible outcomes.

Article 12 of the Packaging Ordinance of 1991 lists the general packaging requirements, which states the need to reduce "volume and weight," ensuring necessary "safety and hygiene" and "consumer acceptance" of the product to be reused or recovered and to minimize the "environmental impacts" arising from the "recovery or disposal of packaging waste."

Manufacturers and Distributors Role

Lindhqvist's (2000) study states that the German packaging ordinance has imposed regulations on manufacturers and distributors to "collect and recycle their used packaging independently or through their entities." In this way, the packaging waste ordinance based on the E.P.R. has been put into effect through legislative means, ensuring the final disposal and recovery of the waste. The study of Nakajima and Vanderburg (2006) has claimed that "manufacturers (produce or import packaging or packaging materials) and distributors (put the packaging or packaging materials into circulation) have a joint responsibility." As it clearly states, the "joint responsibility" of both parties stipulates that the objectives of the E.P.R. have been developed further for better management of packaging waste.

As per the new scheme, every shop above "200 m^2 shop areas" are obliged to collect back drinking beverages sold of the same packaging material. In such instances, retailers can also be concerned as distributors, even if they do not "take care of the initial take back from users" (Nakajima and Vanderburg, 2006). Therefore, it seems that the manufacturer, distributor, and retailer are engaged in being a part of the mechanism towards achieving the objectives raised under the ordinance.

Lindhqvist (2000) claimed that the German Packaging Ordinance is concerned "on the Closed-Loop Economy and Waste Law." The claim which the study of Lindhqvist (2000) made is evident as the ordinance forces the distributors and manufacturers to collect back the packaging waste materials and recover at its end lifecycle.

Producer Responsibility Organisation

Producer Responsibility Organization (P.R.O.) is a private entity playing a vital role as an optional organisation under the German Packaging ordinance. Duales System Deutschland (D.S.D.) performs a "waste management system" for the companies devastated by the ordinance. D.S.D. is funded by member companies to "manage the waste" compliance with the ordinance (Nakajima and Vanderburg,2006).

Nakajima and Vanderburg (2006) state that companies place a "Green Dot symbol" on their packaging to recognise D.S.D. Members. This labelling is an effective system as the consumers will no longer face difficulties finding a disposing method as confirmed through the labelling. On the other hand, it stipulates that the sole responsibility is on the manufacturer and distributor where municipalities will no longer engage in the collection.

Figure 3. Green Dot License Symbol
Source: PRO Europe (2019)

The companies introducing packaging to the market set up their agreement with D.S.D., a private body for utilising symbols on their packaging. The studies have highlighted the effectiveness of the "Green dot System" towards efficient recycling in packaging waste. The presence of the symbol stipulated that they have paid a fee for future collection and recovery. This labelling would impliedly be carrying a market attraction in the mind of the consumers. However, D.S.D. does not carry out the collection and recovery on its own but contracts disposal partners to take back sort and recovery activities (Kaps, 2008).

Impact of German Legislation in Plastic Recycling

The findings of Nakajima and Vanderburg (2006) highlighted that in 1993 there were "500,000 fewer tons of packaging" compared to the year 1992. They declared that the reason for such difference is due to the avoidance of "unnecessary packaging (E.g., shrink-wrap and blister packaging)" and the use of "refillable packaging" as per the packaging ordinance (Nakajima and Vanderburg, 2006).

The study of Nakajima and Vanderburg (2006) highlighted the reduction of "undesirable materials" for packaging and the increase of "redesigned packaging" to minimise the material quantity. Further, they highlighted the reduction of the use of "polyvinyl chloride (P.V.C.)" and increased use of "recyclable plastics, e.g., polyethylene and polypropylene" (Nakajima and Vanderburg, 2006).

As given below, Table 2 shows the survey conducted by D.S.D. in 1992 focussing on packaging materials used in the aftermath of the German packaging ordinance. The survey has been conducted on "8600" licensed holders having a "12% of response rate" (Nakajima and Vanderburg, 2006).

Table 2. Changes of the packaging materials in 1992

	Actions with the Packaging	Percentage
1	Redesigned/ reconsidered (Nakajima and Vanderburg, 2006).	"66%"
2	No changes (Nakajima and Vanderburg, 2006).	"17%"
3	Recycled materials (Nakajima and Vanderburg,2006).	"25%"
4	50% recycled materials (Nakajima and Vanderburg,2006).	"21%"
5	The percentage did not increase the number of recycled materials (Nakajima and Vanderburg, 2006).	"60%"
6	To use 27% recycled materials by 1994 with an increase of 50% in the future (Nakajima and Vanderburg,2006).	"33%"
7	Stopped using composite	"63%"

	materials (Nakajima and Vanderburg,2006).	

Source: The author created the table gathering data from Nakajima and Vanderburg (2006).

"Oils and chemicals derived from used plastics may cost double or triple that of oils and chemicals produced from raw materials." According to Nakajima and Vanderburg (2006), the "raw materials recycling processes (back to-plastics recycling) cost 250 to 800 DM/ton and new recycling methods (back-to-feedstock recycling) cost 550 to 1,500 DM/ton."
As per the free-market system, consumers finally happen to bear the price of the product. Therefore, it is vital to consider customers' desire to pay a higher price for "recycled product" rather than for "a normal product" (Jonsson et al., 2011). However, on the other hand, the economics could easily change when one considers the approach of peak oil and the accompanying steep rise in the oil price (Nakajima and Vanderburg, 2006).

Nakajima and Vanderburg (2006) claimed that there is a limited and unstable market for recycled plastics. However, an "unstable market" for recycled plastics may have resulted from higher expenses for recycling and sorting. Hence, this shows that identifying a market for recycled plastics is imperative while increasing the recycling goals.

The study highlighted that the "O.E.C.D. (1998) does not expect viable markets for recycled materials". They also claim that "recycling of plastics subsidises," which "contributes to the D.S.D.'s high cost." "Ordinance weaknesses" are the issues associated with plastics recycling (Nakajima and Vanderburg, 2006).

Through the literature review findings, it has appeared that laws governing plastic waste are inadequate for solving the emerging issues and challenges of P.C.P.P. waste in Sri Lanka. There is a lacuna in the domestic jurisdiction in addressing the responsibility of the manufacturers and distributors towards the products' life cycle. The emphasis on the five "R" principles is highly undervalued in the domestic jurisdiction. In consideration of these, the effective management of plastic waste is a challenge in Sri Lanka.

4. DISCUSSION

The researcher has identified through the literature findings of the study that legislative enactments play a vital role in managing plastic packaging waste. Dahlén and Lagerkvist (2010) highlighted different regulations on "effective collection systems, decentralised waste recycling centres, social technology (recycling), regulatory policies (pay-as-you-throw) and environmentally friendly waste treatment technologies" as overcoming issues with plastic packaging waste.

The study of Morlok et al. (2017) declared that "Waste Disposal Taxes, Waste Pricing, Deposit Refund Schemes, E.P.R., Tradable Permits, Recycling Subsidies, Value-Added Tax" as exemptions for repair and recycling and identified as "economic instruments" those implemented through national or regional waste policies.

The *Eurig Estate case* (1998) defined the distinction between the "fees and taxes" considering the E.P.R. regulations. However, Xu and Gursoy (2015) argue that the consumers ought to bear the extra cost involved in such redesigning because of the free-market system. The study (Bury 2010) pointed to the effectiveness of working towards the eco fee inclusive pricing model across the country by implementing E.P.R. regulations. The study highlighted that the visibility E.P.R. fees are not consistent in European Countries.

The success of German law depends on national E.P.R. policies. As a result, Germany recycled "more than half of municipal waste." German Packaging Ordinance is focused on material recycling, whereas collection and separation are the objectives of the Packaging Ordinance 1991. Sas et al. (2015) pointed out that "separation of parts" and "quality of recycled materials" are crucial in recycling. According to the findings of William, 2005, there are two general

systems of separate waste collection. Identified as "bring" (delivery to the central collection site) and "collect" (Kerbside Collection of particular waste) systems. Further, he has highlighted that the source separation is vital in either system.

The ordinance has encouraged industries to "reduce packaging materials" and force manufacturers and distributors to come up with sustainable "innovative packaging" (Steven, 1995). Therefore, the present work has identified that German jurisdiction forces the industry to decide on their P.C.P.P. waste disposal issues and design the packaging material efficiency.

As Nakajima and Vanderburg (2006) claimed that producer responsibility is not only an "environmental policy" but also an "efficient" way towards sustainable "product design." The study highlighted that manufacturers and distributors would change the product design to minimise the cost of following the German packaging ordinance.

In Sri Lanka, "Kerbside collection" is conducted by local authorities and by private plastic collectors licensed under C.E.A. However, they are unsuccessful in waste collection due to a lack of demand for all types of P.C.P.P. waste and improper collection in areas governed under the Pradesheya Saba Act. Therefore, it is crucial to close this loop to prevent and avoid the pollution arising from the P.C.P.P. waste in Sri Lanka.

The controlled E.P.R. system would contribute to improved recycling rates and a reduction in P.C.P.P. waste in the event of compliance. German ordinance forces manufacturers and distributors to take back their packaging waste for final recoveries of P.C.P.P. waste either through a private entity or by themselves. The researcher suggests appointing a private organisation to collect, recover, and recycle the P.C.P.P. waste on behalf of distressed manufacturers and distributors. The researcher has further identified that updating data on plastic packaging and packaging waste quantities is crucial.

Manufacturers need to be forced through regulations to use recycled material instead of virgin plastic materials for their plastic packaging. Nevertheless, as Jonsson et al. (2011) pointed out, it is crucial to consider whether recycling costs are higher than the price of the product or whether it saves the cost for remanufacturing the product.

Companies that reduce their volumes receive a reimbursement. The use of recycled materials in their packaging is identified as a "motivation factor" as various studies have suggested that waste incentives are effective in "motivating" people to recycle waste (Abila and Kantola, 2019).

Further, it is vital to introduce a "financial symbol" similar to the "Green Dot" in Sri Lanka to issue a certificate or trademark attached to plastic packaging by the companies to confirm the final disposal and recovery of their packaging waste. Germany intended the assistance of a private entity administering the dual-process for recycling to avoid "government intervention in markets" (Steven, 1995).

Lindhqvist (2000) claimed that "the philosophy of giving the private sector a 'free hand' to make product changes and manage wastes identified as the most effective and flexible means of regulation. Therefore, it is evident that the implemented German Packaging Ordinance cooperating with the private sector has resulted in efficient and effective plastic waste management in Germany.

As a result, the German example helps fill in the domestic jurisdiction gaps by enacting national waste management rules in Sri Lanka that defend producers' duty for plastic packaging trash. Packaging is necessary for society to transport, protect, store, and market products. Therefore, Government policy should encourage innovative packaging designs and uses before implementing regulation targeting the manufacturers. (Costa, Massard, and Agarwal, 2010)

It is easier to sort, recover and recycle the P.C.P.P. waste with a proper packaging design that concerns material efficiency. One can achieve this by enforcing regulations on minimising packaging quantities and maximising the material efficiency in the packaging. Packaging minimisation in

manufacturing involves efforts to avoid creating P.C.P.P. waste. That further guarantees the high recycling rates, and further this will increase the high-quality recycling due to quality secondary material as those not contaminated with other residual waste.

It is required to implement the E.P.R. regulations with the circular economy, cradle to cradle, polluter pays principles. However, the applicability of these principles varies due to whether the country is either a developed or developing country. German regulations concerned with recycling targets hinder focus on the national market economy.

Therefore, it is required to implement the regulations concerning the national market economy and an adequate technical recycling system in Sri Lanka. Lessons from German experiences help fill the domestic jurisdiction gap by implementing national laws on producers' responsibility for the plastic packaging waste in Sri Lanka.

5. RECOMMENDATIONS

Packaging waste management in Germany evolved in the past 30 years. Germany's legislation resulted in packaging waste minimisation, resulting in fewer landfills and incinerators. The researcher has identified that the relevant authorities should regulate the manufacturers' and distributors' responsibility for their plastic packaging guaranteeing final disposal and recovery at the end of its life cycle. The researcher suggests implementing regulations on mandatory collection and recoveries of P.C.P.P. waste either through private entities or manufacturers and distributors. Those who cannot sort out, collect and recover P.C.P.P. waste by themselves should get aided by private entities in exchange for a license fee for the collection and recovery process.

The proposed recommendation is to impose regulations on shops with more than "200m2 shop areas" to take back drinking beverage packaging from the consumers and finally hand over the beverage packaging back to the manufacturer. Here, the role of the retailer becomes similar to that of the distributor. For mandatory updating data on collected quantities of P.C.P.P. waste is recommended.

The design of the packaging is the best place to implement zero waste. Manufacturers of plastic packaging should encourage adopting cradle-to-cradle design principles. When packaging design is resource-efficient through the cradle-to-cradle principle, it will be easier to sort, recover, reuse, and recycle waste. Therefore, this research suggests the presence of regulatory guidelines during the manufacturing stage to prevent the generation of P.C.P.P. waste.

Recommendation on Tax breaks and financial incentives helps to promote manufacturers of ecologically friendly and sustainable plastic packaging. On the other hand, landfill tax and incineration tax on the manufacturers and distributors will deter them from producing non-degradable and non-recyclable P.C.P.P.s.

Manufacturers who reduce the amount of packaging and use recycled materials instead of virgin polymers should receive rebates. Further, the Government must restrict the production of single-use plastic packaging.

Like the green dot system (Duales System Deutschland), Sri Lankan manufacturing companies shall receive a certificate or symbol (trademark) attached to the plastic packaging to approve the final sustainable disposal of the P.C.P.P. waste. Therefore, the recommendation to impose regulation on manufactures for mandatory take back and recovery of P.C.P.P. waste is essential. Therefore, the Government should mandate the setting up of bins to enable the collection of disposed of recyclable packaging waste by the manufacturers or by the private organisation on behalf of the companies licensed under a green dot system.

As it is not the Government's responsibility, it is better to have a separate private organisation to collect the P.C.P.P. waste on behalf of the manufacturer and appoint a coordinating body standing between the central environment authority and the local authorities to monitor the enforcement

and implementation of regulations.

6. CONCLUSION

It is qualitatively analysed and discussed that the regulation towards preventing and reducing P.C.P.P. waste is the most crucial component of effective plastic waste management in Germany. Sri Lanka's plastic waste laws, on the other hand, do not mention these principles. This study identified that the E.P.R. plays a significant role in managing packaging waste in the German Packaging Ordinance. Further, enforceable regulations on packaging compel the producers to innovate sustainable packaging to reduce P.C.P.P. waste in Germany. These regulations on packaging waste aided in packaging waste minimisation in landfills. However, Sri Lanka's plastic waste laws do not identify the E.P.R. towards the manufacturer. According to the study's findings, the German packaging waste ordinance has ultimately helped the increased recycling of P.C.P.P. waste and the reduction in production and ultimately the mitigation of the P.C.P.P. waste end-of-life cycle in the environment.

Accordingly, this study aims to fill a gap in the domestic jurisdiction by focusing on the national policy on legislatively implemented E.P.R. for the prevention, reduction, disposal, and sorting of P.C.P.P. waste. Recommendations for a national policy on plastic packaging incorporate concepts such as cradle-to-cradle design, the polluter pays principle, and the circular economy to prevent or reduce PCPPP's impact on the environment in Sri Lanka. However, achieving the desired economic outcome depends on effective recycling technology and the market economy for recycled materials.

The manufacturer is accountable for managing the P.C.P.P. Waste end-of-life cycle. The bench and bar are a part of the law enforcement process (Abeysekara, 2015) beside the Government. Therefore, enforcing the law is not a laidback task. As learned from Germany that enforcing regulations on manufacturers and distributors for sustainable packaging and prevention, reduction, disposal, sorting, recycling, reuse and reuse at the end of its life cycle is critical while considering Sri Lanka's socio-economic and geographical circumstances.

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EVALUATION OF THE LAW RELATING TO MEDICAL NEGLIGENCE IN SRI LANKA

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ABSTRACT

Reasonable competent and skilled medical practitioners owe a duty of care to their patients. Medical negligence and malpractice are expressions that are used in the medical community very often. It is hard to collect a handful of successful Sri Lankan case law documents that reached the Supreme Court. However, an exception exists from the landmark case of Priyani Soyza v. Rienzie Arseculerathe for the Recovery of Damages for the Death of a Person prior to enacting Act No.2 of 2019. This case law is just a tip of an iceberg. Many more merits have still been under-reported. Prevailing tort liability of medical negligence in Sri Lanka is neither the best nor certain. The professionally skilled staff owe a huge debt of gratitude to their clients to perform a reasonable duty of care. However, when it comes to human health, the professional relationship becomes livelier and more sensitive. Negligence is a common terminology in any profession, occupation, business, or trade where a prudent person would not reasonably omit or commit, resulting in ultimate physical, mental, or economic loss. The growth of science and technology and free health policy in Sri Lanka have been taking an immense struggle through legislative, international conventions case laws, and eminent legal commentaries to fulfill the patient-oriented medical system. This paper aims to analyse and evaluate the ups and downs of the Sri Lankan legal system regarding medical negligence while comparatively introducing successful sources from other jurisdictions. Primary and secondary data collected were analysed using the qualitative research approach in this study. In this study, the qualitative research approach was used and data for analysis were gathered from both primary and secondary sources. In conclusion, admire the hypothesis and recommendations of the successful green pasture oasis used in consumer protection law, professional insurances, and non-fault redress for prevailing tort-based Medical Negligence.

KEYWORDS: *Medical Negligence, Sri Lanka, Insurance, Consumer, Profession*

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1. INTRODUCTION

Negligence in the general

The modern law concept of Negligence lights up with the concept of 'love your neighbours' from the wording of Lord Atkin's 1932 case law of *Donoghue v Stevenson [(1932) A.C.562]*. Thus, with the merits of the Negligence, the interpretations from *Palsgraf v Long Island Railroad Corporation (248 N.Y. 339), Hay or Bourhill v Young [(1943) AC 92], Caparo v Dickman [(1990) UKHL 2], Hill v Chief Constable of West Yorkshire [(1987)UKHL 12], and Osman v UK [(1998) ECHR 101]* grow up with new vocabulary including foreseeability, proximity, fairness, justice, and reasonableness even in the absence of a contract.

So, the traditional definition of negligence brings up the idea of taking reasonable care to avoid acts or omissions that can reasonably foresee the damage to your neighbours and your ultimate consumer. Theoretically, the law used to satisfy duty, the breach of duty, damage, and causation with four elements to establish Negligence, according to the authority of *Lochgelly Iron and Coal Co v McMullan [(1934) AC1, 25]*.

Medical Negligence

Medical Negligence is a special branch of Negligence. It leads to complaints or litigation about an inadequate standard of medical care given to a patient. *Bolam [(1957) 1 WLR 583]* test is like an indicator that looks for four elements in the failure to perform the owed duty. Thus, the author is advising the reader to look for a reasonable degree of skill and care in diagnosing and treating a patient causing damage in some bodily, mental, or financial disability in most countries. There are civil societies and non-profit organizations that provide defence and insurance to their medical professional members. Civil medical negligence and Criminal medical negligence are the two types generally followed by every jurisdiction worldwide. Medical negligence litigations are very serious and need a deep concentration with medical and legal technological and terminology practicality. In reality, there are few alleged medical negligence cases reported. Some cases have gone up to courts, and most of them have settled outside. So, it is hard to find a simple or clear-cut medical negligence litigation that awards compensation. Often the lawyers have to collect a great deal of information and wisely analyse all circumstances. Ankur Arora Murder Case (Tatari. S, 2013) is a brilliant movie directed by Mr. Suhail Tatari, which brings to the limelight a well-known medical professional's act or omission to perform an owed duty that caused medical negligence. It is a story of an innocent boy who could not survive due to negligent pre-operational care after an appendectomy. However, this boy's mother is capable enough to expose the fatal flaws in the medical profession throughout the film.

2. METHODOLOGY

Research information is valuable for gathering knowledge and sharing knowledge in an especially arranged systematic methodology, hoping for a scientifically worthy outcome. So, scientific outcomes favour cumulative common features through ontology and epistemology of the paradigm. Thus, the present study attempted to evaluate the existing laws and legislations analytically. Comparing Sri Lankan legislation with other relevant, effective, good governance standards is therefore required to be done by allowing access to the human rights of those other countries. In doing so, the researcher followed a qualitative research methodology.

The researcher was able to gather primary and secondary data with the aid of the black letter technique. Authentic books, journal articles, conference proceedings, and other online sources are secondary. The desk research review is the commonest elaborative method available those days with Covid pandemic and health restrictions. Special attention has been given to the comparative analysis pathway to evaluate Sri Lankan and successful international jurisdictions. Next, with empirical research observations, the study clarifies the difficulties in establishing medical negligence laws and practical ways of introducing country-oriented own inherited norms along with human rights internationally accepted.

3. RESULTS

Civil medical Negligence

Sometimes civil medical Negligence is known as malpractice (Chandrasiri. N, 1999). In general terms, all patients have the right to expect satisfactory, standard medical care, treatment, management from admission and aftercare. Everyone completes their duty with self-confidence and guarantees success with the academic and clinical practices they gain from training and experiences. But sometimes, biological factors play an important role in producing an unpredictable outcome. However, the patient is entitled to receive financial compensation if they can prove the harm or loss resulting from the commitment or inability to perform the medical professional's reasonable standard of medical care. The rationale of awarding damages by a civil court is to renew the financial loss suffered. Every Sri Lankan civil court (district court) can award compensation for physical or mental damages caused by a breach of owed care by a medical practitioner. The most important question that courts ask is whether the respondent doctor would have done or omitted doing what an average doctor of the same seniority and experience would have done in an identical circumstance regarding the patient's condition and the location of the examination and treatment conducted. Sometimes, there are crystal clear situations where "things or facts speak for themselves" (res ipsa loquitor), and that situation shifts the burden to prove to a medical practitioner. In some situations, the civil courts have to adopt the procedure to find out from peers about opinions regarding medical issues. The experts consider the details of the case to check whether a reputable and acceptable medical practice performed that act.

A medical malpractice insurance policy is available in many countries to safeguard patients against doctors who breached their professional responsibilities. So, under civil cases, even a seriously harmed patient cannot get any certain compensation in this tort system if the matter fails. The general sense is that the legal process is very slow, takes several years, and involves a lot of expenses. Therefore, only a few people will bear the time and money consumption at the medical negligence litigation. To overcome the unfairness in civil litigation, most countries like New Zealand, Finland, Sweden, and Norway introduced the no-fault system to their victims seeking compensation. This system tests not the medical practitioner's Negligence but the patient-centered safety. Patients who choose no-fault insurance get reimbursed by their companies, workers, and the state.

A no-fault system is like a strict liability that does not need proof of damage caused. The patient's only thing to prove is that the medical professional breached the owed duty to care to receive compensation for the damages. As there are two sides to one coin, the only disadvantage of the no-fault system is that this system can pay only a small quantum. A no-fault system is a method that is for all or nothing. Accordingly, the burden of proof has to achieve at least fifty-one percentage to win the claim.

On the other hand, if the result is forty-nine percentage, then the patient gets nothing. He/She loses everything available in the case matter. So, this frustrates the severely affected patient if they do not file a tort suit at civil courts against the medical practitioner who breaches the owed duty of care within his authorised profession. Litigations are extremely expensive, and they take a lot of time. Usually, rich people and poor people who gain legal aid can fight for this. Another sad situation is that it is extremely difficult to get a medical opinion in favour of a patient who suffers the breach of Medical Negligence. Expert views and secondary opinions do not help much in these cases as most professionals usually refrain from voicing their thoughts against their peers in their respective professions.

Duty of care

Under the definition of medical Negligence (Knight. B, 1992), a medical practitioner should be under obligation to his/her patient from the beginning of the consultation and admission of the patient. It is unnecessary to prove the relationship between the medical professionals and the patients as it implies with the commencement of the treatment. The relationship between those medical professionals and their patients is strong (Alwis. L. B. L, 2011). They promise and pledge to do their best in the interest of the patient

always. The government hospitals of Sri Lanka are free of charge. When a patient admits to a hospital, the nursing staff assign them to a ward, and the obligation towards the patient begins thereon. Then the patient is assigned to be under the supervision of a senior nursing officer in charge and respective authorized doctors (Jayawardena. H, 1994). All payments include from the government's revenue, derived from taxes paid by citizens. The same process is in private hospitals from the onset of the consultation relationship between the medical professional and the patient. However, the patients have to bear the costs of the consultation fees, admission fees, treatment, and medical care themselves. This is a pathetic situation which is far beyong what medical practitioners are promised and pledged.

Skill and care

The next important issue is, whether a reasonale degree of skill and care is indicated on the part of the medical professionals. There is no guarantee that a hundred percent success can be achieved in all treatments, operations, or in anything medical professionals do. But things done or omitted can worsen a patient's condition, which can be tantamount to professional neglegance.

The standard of care and skill

Health care providers do not have to provide the greatest level of care or expertise under the current standards. Also, it is not enough when there has been a minimal degree of skill than the general professionals expect. But things done or omitted can worsen a patient's condition, which can be tantamount to professional neglegance.

The standard of care required is not the exceptionally brilliant character of a medical professional. Being a physician, a surgeon, or a nurse cannot guarantee absolute care and safety. So, those medical professionals are not liable when something unexpected happens. Negligence is not a mere slip or a mistake. However, the standard necessary for the law differs according to the given circumstances. For example, a severely injured person with severe bleeding may seek treatment from a rural hospital that lacks the required facilities to treat such a person due to heavy traffic. Even though the medical staff and doctors start treatment with their maximum efforts, the patient may die due to the lack of required facilities in that hospital. It is not medical negligence.

On the other hand, even when a newly qualified physician or a surgeon undertakes a duty, the standard of competent skill and care expected from such a specialist may not reach similar to an experienced professor in the relevant field.

The standard of care can differ according to the emergency and the priority of saving the patient's life. The general practitioner is not a qualified professor in the field expected to exercise under the reasonable standard of care and skill. But medical professionals do not excuse themselves when careless as a layperson.

Causation and damage

A patient is awarded compensation for the breach of professional medical Negligence only at the evidence of damages. Damages have to be by the negligence of a medical professional's owed duty, but not by the consequences. The patient must prove that damage could not have occurred but for the medical professional's negligence.

Sri Lankan judges' quality of the standard view

Competent medical practitioners always check the quality of the medical practices in the field based on the evidence. So, the most relevant and only reported case in Sri Lanka is none other than the Arsecularatne vs. Soyza case. In 1994, the District Court of Colombo called for a neurologist, neurosurgeon, and two Professors of Paediatrics to obtain secondary medical evidence. According to the case facts, the parents of the baby Suhani Arsecularatne had consulted the defendant, Prof Priyani Soysa, a consultant paediatrist at Navaloka private hospital. Even one month after treating the patient, there were no signs of recovery or healing other than the deterioration of her condition. Eventually, the child had died. The misdiagnosis of Priyani Soysa, according to the trial court, may have been averted if the respondent Paediatric had paid more attention to her patient.

At the Appeal Court, judges found the medical practitioner negligent in taking a proper patient history. Also, she had failed to record the history taken and had

prescribed a simple investigation called CT scan for the baby patient. The trial indicated that the diagnosis of rheumatic chorea without recording and considering inconsistent symptoms with such diagnosis was the mistake. However, in practice, shortcomings are accentuated because physicians do not document clinical observations. The courts need every reasonable evidence of everything that the medical practitioner has done to make a reasonable decision according to the circumstance. In the case under discussion, the court could conclude if the bedhead ticket of the baby Suhani had reasonable notes. Generally, the medical practitioner records the patient's important positive and negative features and not everything in the bedhead ticket. However, the Court of Appeal declared that "a doctor who considers too important not to condescend to write history on a bedhead ticket or make referral notes herself cannot be expected to have treated the child or parents with care and respect, nor given herself sufficient time to investigate and reconsider her initial diagnosis of rheumatic chorea." The trial judge's view was that "Negligence is a feature of the present and past if admitted in law. A doctor shall treat the child to the best of the practitioner's ability, irrespective of the future outcome.

One cannot use an extended peep into the future with the knowledge of medical science as it exists in the present as a weapon to ward off the evil effects of our present or past action." Recovery of Damages for the Death of a Person Act (Recovery of damages, No.2 of 2019) to determine parties on the death and loss of love, affection, care, and companionship has become the latest reference. Thus, the next-of-kin with a wide range of variety individually or jointly as a parent, child, sibling, grandparent, a guardian can appear before the courts on behalf of the dead person of an action for damages caused by a medical professional's breach of an owed duty by a wrongful act, omission, negligence, or commission against a reasonable person. Lack of case laws in negligent medical law recalls for more reforms. There is a need for a gradual fulfillment to Acquilian Action to recover damages other than patrimonial loss or physical hurts. Earlier, there was no compensation for mental distress, physical injury, loss of care, and companionship. The Recovery of Damages for the Death of a person Act No. 2 of 2019 has introduced several legal qualities overlooked since the landmark case of Prof. Priyani De Soyza versus Arsecularatne ruling, handed down in 2018.

Duty of medical practitioner and rights of patients

Generally, Americans are used to practicing the patient-oriented standard. According to *Canterbury v Spence (464 F.2d 772)*, the patient has the right to inform, and medical professionals are under a duty to disclose all the information. But the final selection is with the patient. The British form a medical professional-oriented method. According to Sideway, the doctor has the selection of what to disclose and not to the patient. The medical practitioner should always be aware of recent developments as common knowledge, including accepted methods in history taking, clinical examinations, investigations, diagnosis, treatments, prevention, therapies, and care after treatments. In some situations, a junior works for long hours, and tiredness or being untrained can lead to losing skill in making judgments. So, there can be situations where these fatigues or lack of knowledge may lead a person to neglect a necessary step or to follow an incorrect procedure, and it may lead to the breach of one's owed duty as a medical practitioner making him/her liable to pay medical negligence compensation awards. In practice, there were many incidents that an untrained blood bank medical officer's incompatible blood group caused the death of a patient. Also, doctors, nurses, pharmacists, and other relevant medical professionals should consider the warnings, circulars, quality failures, side effects sent through health services and regulatory committees regarding drugs. There is no excuse for being in a rural area or a village. Reading a recognised journal like Ceylon Medical Journal, British Medical Journal, and Lancet is very helpful to gain new knowledge. As a practice, a medical professional enters all information in bedhead ticket from the arrival of a patient for diagnosis, clinical findings, investigations and even consequences and follow-ups after discharge. But most of the busy senior doctors in Sri Lanka are used to writing a minimum or they ask their juniors to write in detail in the bedhead ticket.

The duty is to inform complete information to the patients about the risk of a proposed treatment while giving detailed benefits of the treatments. The patient is

entitled to know the situation even when he/she is anaesthetised. Even though the medical professions do not need to admit Negligence, patients have a right to know everything to the fullest disclosure. Particularly, the patient should know the committed and omitted things even when things go wrong. When competent medical professionals are brave enough to follow a procedure that has not been used yet for the first time without approval through clinical trials or science to save lives, that is not considered an accepted practice of medicine. So, in these circumstances, the patient has a right to be well informed of the procedure of the experiment.

However, the old fashion has to tail off and act as minority practice when new technology goes better than the older methods. So, the patient has the right to ask for newly accepted technology in their medical care procedure. Another interesting fact is that, in Sri Lanka, proving medical Negligence against medical professionals is a stranger subject matter than in other countries. Common people cannot compel doctors or other medical professionals to provide their medical records or to those of their relatives. Even the law has not yet considered this area much. Although patients have a right to get a copy of their medical records, even if they are the property of doctors and hospitals, they must pay a small fee to do so. Sections 33 to 35 of the Supreme Court Act, 1981 of England (*Supreme Court Act, 1981*) provide the High Court authority to order, possess, and disclose all documents before filing a case.

A complaint was made on medical negligence liability to doctor and the hospital consider according to common law authority in McCormack v Redpath Brown and Company and another (Lancet, 1961:736.). But the final declaration was that the hospital needed to pay damages considering that the young and careful doctor had done his best in the circumstances even though he had lacked sleep and had been tired working for thirty hours. That is a good example that suits Sri Lankan situations with understaffed status and lack of facilities in unprivileged government and private hospitals. Sri Lankans followed English or other jurisdictional cases blindly, expecting to perform beyond available resources without thinking about the real condition and standard of care in those countries.

Criminal medical liability

The burden of proof that expects in criminal offenses is beyond a reasonable doubt. When pursuing a criminal medical negligence case, one must show that the level of carelessness involved warrants criminal prosecution. In civil medical Negligence, a patient who suffers can make a complaint against a medical professional with the intention of financial compensation, which is the most famous type in most jurisdictions. Punishments as punitive compensation awards to the alleged criminal medical negligence. Required men's rea is an amount of deliberate wicked, reckless, rash, or scant disregard towards their patient's life and safety. Generally, criminal medical Negligence in Sri Lanka before the magistrate court or the high court in litigation. Sometimes this kind of criminal wrong can be considered much more serious than Negligence at judgments. There is no malice or pre-mediation to destroy the patient's life, and the direct-action situation is different from murder. But the severe carelessness or lack of forethought can be considered as culpable homicide not amounting to murder according to Sri Lankan Penal Code and manslaughter in the United Kingdom. According to section 328 of the Sri Lankan Penal Code, a medical professional is liable for a criminally negligent act of rashness causing patient hurt. The punishment is a maximum of six-month imprisonment and a fine. Section 329 is for grievous hurt caused by the negligent act with the award of two-year imprisonment and a fine. Finally, if the negligent act causes death, the courts can give a five-year sentence of imprisonment and a fine. Actually, in practice, there have been a very limited number of criminal medical negligence charges for the breach of owed duty by medical practitioners in jurisdictions worldwide, including Sri Lanka. Most probably, the reason is that states that have the power are reluctant to prosecute the noble people in the medical profession. But someday, states will prosecute medical professionals for their breach of owed duty for the commitment of Negligence, like damage caused due to the influence of drugs or alcohol or caused during a trade union action by failing to attend an emergency service. Civil responsibilities can ask to have immunity form trade unions. But, considering the patient's best

interest at the circumstance criminal commitment looks in different spectacles.

4. DISCUSSION

Medical professional insurance

A typical insurance policy responds for bodily harm or property damage, and other forms of insurance cover employers, product liability, and any other general circumstances only. But medical professions can give rise to legal claims under the name of medical Negligence. But, authorities are reluctant to perform without any specific clause in those general policies in insurances. Under professional liability insurance, special policies like error, omission, or negligent act committed in the insured's medical professional duty based on circumstances are obliged to cover claims made during the policy period. The majority of American doctors, dentists, psychologists, pharmacists, optometrists, nurses, and physical therapists require consider this type of medical insurance for their professional careers. Depending upon the location and nature of the medical practice, insurance differs. Sometimes federal (USA) government made the insurance against medical negligence liability to protect the medical employees. Generally, medical professional insurance coverage seeks to protect medical professionals and the business surrounding too. All the expenses in medical Negligence litigation, including attorneys' fees, court costs, arbitration costs, settlement costs, compensation, and medical damages, are usually considered under indemnity covering. Medical professional insurances do not cover criminal acts, sexual misconduct, and misbehaviours. As a patient-oriented country, the USA always intended enhanced patient safety and non-judicial compensation by replacing tort liability.

No-fault system

The no-fault system is a new successful area introduced at the failure of civil and criminal medical Negligence practice in Sweden, Finland, Norway, and New Zealand. It does is not seek the doctor's Negligence at a breach of owed duty but always pays attention to the patient's need. Even though no-fault is a supplement with advantages, there are few regrets in this system too. The main disadvantage is the difficulty in identifying a qualified subjective area for compensation. The no-fault system is unfair for the patients who suffer serious medical Negligence as the compensation award is minimal and hardly pays large monetary amounts. Funding comes from the government, local council, and physicians. The basic steps to a no-fault system are so flexible. The victim patient makes an application to get compensation for medical negligence (malpractice). Then, a notification made by an expert panel to the physician has to give a written report about damages and procedures. Next, during the primary investigation, the eligibility of the application and medical report has to be determined. If the patient is supposed not to appear before the court, the panel has to interview the physician. The panel also can call for witnesses when necessary. The no-fault system does not intend to replace the court system. Within six months, payment for medical negligence compensation for violating a duty of care is made.

Consumer Protection Act

Magna Carta is the first charter that took the attention of the consumer. To protect the consumers within the wider business network, in 1986, the new Bill of 2019 (Consumer Protection Bill, 2019) replaced the exciting Act of Consumer Protection in India. The consumer disputes redressal forums are the statutorily established courts especially to hear consumer litigations. Section 7 of 2019 (2d of old Act) identifies a person who avails a service for a consideration known as a consumer. At the same time, the deficiency of service leads to an injury to the consumer by any act of Negligence or omission or commission defined under section 11 of the new Act (2g of old Act). The multiplier is a successful compensation calculating method. During the 90s, Mrs. Auradha Saha visited her hometown Kolkata, India. On the journey, she died due to an overdose of a wrong drug prescription by a negligent doctor who treated her skin allergy. Her husband, doctor Kunal Saha initiated the legal battle against the negligent actions of medical professionals that led to the death caused by a breach of an owed duty. Mr. Kunal Saha has relentlessly fought for fifteen years to establish justice for innocent patients like her wife. On 7th August 2009, the Honest Supreme Court of India held four Kalkata based doctors and AMRI Hospital of Kalkata guilty for the death of Mrs. Auradha Saha in a historic

judgment. The highest consumer court of the Indian National Consumer Disputes Redressal Commission (NCDRC) made the award for late Anuradha. Until now, this was the largest sum of money ever paid out in India. Awarded compensation is 1.7 crore of Indian Rupees on October 21st, 2011. Indian society is more active, and many organisations and societies have risen like 'People for Better Treatment' (PBT, 2014) to bring safety towards the victims of medical Negligence. However, the Indian Consumer Protection Act's provisions usually work with the government health institutions, excluding where all services are delivered free of charge. Free of charge services are reluctant to apply under Consumer Protection Act. Even in Sri Lanka, many people keep dying every day due to some breach of medical negligence owed by a medical professional. Sarla Verma and Nizam institution cases are some successful compensation awarded cases. Susamma, Trilok Chandra, and Charlies are the best examples where the development of law looked forward to considering consumer protection with a no-fault compensation method.

In 2003, Sri Lankan law introduced the Consumer Affairs Authority No.9 with the hope of alleviating the weaknesses and limitations with the prevailing legislation by replacing the Consumer Protection Act 1979. As stated in the preamble, it aims to provide better protection for consumers through regulating trade and services against unfair practices. Reiteration of some words occurs in the Consumer Protection Act of India and Sri Lanka (Consumer Affairs Authority No.9 of 2003). For example, section 75 of the Sri Lankan Consumer Affairs Authority Act 2003 defines consumers and services the same way as in the Indian Consumer Protection Act sections 7 and 11. Definitions of consumer and service, in particular, are well-aligned. So, it is a "green light" to get used to consumer protection at medical negligence litigations from Indian statutes and common law.

5. CONCLUSIONS

Sri Lanka can adopt selected comparative methods to enhance patient safety to replace civil (tort) liability. Medical professional insurance method can be a good indemnity to protect the consumer (patient). Government-funded (full or half) for government hospital medical staffs or individual funded (medical professional) insurance against medical Negligence only arising for the provision. The government can make this a mandatory policy, as in some states in the USA. In reality, the prevailing tort liability of medical negligence compensation in Sri Lanka is neither certain nor punctual, nor fair. Non-judicial compensation appreciates no-fault compensation systems and Consumer Protection Acts. The no-fault system does not need any evidence of damage caused by Medical Negligence. At the same time, the Consumer Protection Act has to go through with statutory provisions to define consumer services and deficiencies to win the case.

No-fault system medical professionals come forward with their patients to improve the whole network in the medical system. A no-fault system is a flexible compensation award for the settlement of claims within six months. In the Consumer Protection Act, being a consumer has more rights than being a layman. Even though the no-fault system has been in place for almost twenty-five years in some of the world's most developed humanitarian nations, the ultimate award is a tiny amount of compensation. It is an 'all or nothing' procedure that frustrates the patient at times (consumer). A patient, when considered as a consumer, has more rights with medical negligence compensation than otherwise. However, professional medical insurance, no-fault system, and Consumer Protection Act will be better helpers to fill the gap when compared with other jurisdictional methods for medical negligence compensation. The people of Sri Lanka have to be more vigilant and enthusiastic about judicial activism on medical negligence compensation. There are a lot of Suhani Arsecularatnes, Anuradha Sahas dying every day, emphasising the need to enhance consumer (patient) safety with assured compensation for medical negligence. In this context, it recommends analyzing the merits of prevailing medical law and evaluating the protection available to the patient as a consumer through professional medical indemnity insured without any evidence of damages. The modern law concept of Negligence lights up with the concept of 'love your neighbours' from the wording of Lord Atkin's.

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NEXUS OF EMOTIONAL INTELLIGENCE (EI), NEED FOR AFFILIATION (NAFF), INTEGRATING STYLE OF CONFLICT RESOLUTION: A CASE STUDY OF DISPUTE RESOLUTION AMONG UNDERGRADUATES IN SRI LANKAN STATE UNIVERSITIES

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ABSTRACT

Emotions and motivational desires play a significant role in human behaviour. Accurate comprehension and management of those factors influence the behaviour of people. University undergraduate disputes are a heading in many mainstream dialogues in the county. Yet many have looked into it, disregarding the emotional and motivational components. The selection of conflict resolution mechanism mainly depends upon the conflicting party's motivational desire and emotions, but it is unexplored in the Sri Lankan context. Thus this study was conducted to understand how the nexus of motivational desire (i.e., Need for Affiliation (nAff)) and Emotional Intelligence (EI) influence the selection of conflict resolution styles (i.e., behaviour) among undergraduates to bridge the prevailing gap. A survey conducted involved the participation of 388 undergraduates from ten (10) state universities. The measurements were; EI - Wong and law EI scale, nAff - Unified Motive Scales (UMS), conflict resolution styles (integrating style) - Rahim's Organizational Conflict Inventory-II. Moderated multiple regression analysis (hierarchical multiple regression) was applied to test the hypothesis. The results signify that emotionally intelligent people prefer to use an integrating style to resolve conflicts. Further, motivational desires, i.e., nAff (moderating variable), enhanced the relationship between EI and selecting an integrating style to resolve conflicts. It indicates that those emotionally intelligent and highly needed affiliations tend to choose a more productive and collaborative conflict resolution approach such as integrating style. Students' emotional intelligence (EI) levels will rise due to opportunities to strengthen their relationships and EI development programmes. That leads to selecting more productive conflict resolution approaches such as integrating style to manage student conflict better.

Future researchers could enhance the study by adding personality, values, and cultural elements to the model.

KEYWORDS: *nAff, EI, Integrating conflict resolution style, State University, Undergraduates*

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1. INTRODUCTION

Conflict is a natural consequence of diversity due to cognition and social interaction aspects of human behaviour (Popescu and Vasilescu, 2012); thus, it has an inevitable appearance in the social context (Darling and Walker, 2001). According to some workers, there are diverse views about the conflict, and as a negative phenomenon (Jehn, 1997; Pondy, 1967; Robbins and Judge, 2013), must avoid at any cost. A concept (if well managed) can deliver functional results (De Dreu and Van de Vliert, 1997). Conflicts can arise within individuals, groups, parties, or entities (De Dreu & Gelfand, 2008), i.e., *Individual-level conflicts* – a conflict that can take a particular form. These conflicts affect only individual and individual motivation, cognitions, and affective states determine the conflict process. *Group level conflicts* – Intra-group conflicts within an internal group, team, or department and Inter-group conflicts between different groups, teams, and departments. *Organizational level conflicts* – conflicts between different organizations (substantive, emotional, and cultural). Another classification demarcates conflicts into three domains; *Task conflicts* which relate to the content and the goals of the work, *Relationship conflicts* which focus on interpersonal relationships and *Process conflicts* which relate to how the work gets done (Robbins & Judge, 2013). Research indicates low levels of process conflict and low to moderate levels of task conflict can be functional, but any level of relationship conflict is dysfunctional all the time. These findings are not applicable in every context. It is essential to remember that these functions get influenced by many other factors and need collaborative management. Fleetwood (1987) suggests that since conflict is unavoidable, managers must recognize the sources of conflict, view its constructive and destructive potential, learn how to manage conflict, and implement conflict resolution techniques effectively. Predominantly, conflict management strategies determine whether the outcomes are constructive or destructive (Park and Antonioni, 2007).

Emotional Intelligence (EI) is an antecedent of conflict resolution strategies (Shih and Susanto, 2010). Jones (2000) elaborated that human conflict does not exist in the absence of emotions, while Bodtker and Jameson (2001) favourably argue that if a person is in a conflict situation, he must be emotionally charged. Consequently, conflict is an emotionally created and emotionally driven process, and proper identification of emotion involved in a conflict process exposes the opportunities to orchestrate the conflict management productively (Jordan and Troth, 2004; Eadie and Nelson, 2001; Bodtker and Jameson, 2001). Further Human behaviour is essentially formed under the influence of the person's motivations to achieve specific goals (Raeisi et al., 2012).

Motivation is the force within the individual that influences or directs the behaviour (Mrayyan, Modallal, Awamreh, Atoum, Abdullah, & Suliman, 2008) that accounts for an individual's intensity, direction, and persistence of effort toward attaining a goal (Robbins & Judge, 2013). Proper understanding of human motivation is a valuable dimension to predict the causes of human behaviour. McClelland (1987) identified three motivational drivers who drive human behaviour as the need for achievement (nAch), the need for Power (nPow), and the need for affiliation (nAff). If a person has a fundamental need or desire to be with other people, seek and grab the opportunities to interact with other people, such a person is said to be driven by the need for Affiliation (McClelland,1987).

Even though there has been some research on the impact of EI and motivation on conflict (Rahim et al., 2002; Chan et al., 2014; Bodtker and Jameson, 2001; Bell and Blakeney, 1977), scholars have not yet attempted to address the integrative impact of the two on conflict resolution strategy. It is crucial to test the simultaneous impact of the EI level associated with the motivational drive on selecting a conflict resolution strategy to have a more accurate result.

Sri Lankan university undergraduates are known to adopt an aggressive approach to conflict resolution. It is evident through the frequent student clashes, staff-student conflicts, and rivalry (Ruberu, 2003). The closing of universities due to student unrest, the postponement of admissions and examinations due to students not participating in the scheduled programmes, and frequent student protests have given university administration a serious problem. University undergraduate conflict, which is a group-level

relationship conflict, has transformed itself from intra-university issues to national ones (Weeramunda, 2008; Hennayake, 2008). University undergraduates have the most refined intellect among Sri Lankan advanced level students and are the prospected prominent drivers of the country. These privileged few are the cream of the nation with all the potential to take the country to new heights (Hennayake, 2008). Hence addressing their critical behavioural issues is obligatory.

The conflict in human behavior gets influenced by many factors such as emotions, emotional intelligence (Goleman & Cherniss, 2001; Salovey & Mayer, 1990), motivational desire (Robbins & Judge, 2013; Raeisi, Hadadi, Faraji, & Salehian, 2012).

However, even though scholars have looked into the concept of conflict resolution, many have looked into it, disregarding its emotional and motivational components. The selection of conflict resolution mechanism (i.e., behaviour) mainly depends upon the motivational desire (i.e., nAff) and emotions (i.e., EI) of the parties involved in the conflict. Still, these are yet unexplored in the Sri Lankan context. Thus, this research aims to analyse the integrative impact of the EI and motivation towards selecting a conflict resolution strategy bridging the research gap as mentioned above.

The study expects to find answers to 1) whether emotional intelligence influences selecting Integrating conflict resolution style, and 2) whether the need for affiliation moderates the relationship between emotional intelligence and integrating conflict resolution style.

Conflict and conflict resolution

Conflicts have continued to exist everywhere from the very beginning of society. It is a natural consequence of diversity due to cognition and social interaction aspects of human behaviour (Popescu and Vasilescu, 2012); thus, it inevitably appears in the social context. Thomas (1992) defines conflict as "the process which begins when one party perceives that another has frustrated, or is about to frustrate, some concern of his" (p. 891). While conflicts remain static, the way people perceive the same evolved with time. Some viewed conflict negatively and discussed it with such terms as violence, destruction, and irrationality. In this arena, the conflict got identified as an inevitable outgrowth of the social class system or organisation hierarchy that hinders the performance of organisations; it is dysfunctional and essentially needs to be avoided (Jehn, 1997; Pondy, 1967; Robbins and Judge, 2013). Others suggest that conflicts are beneficial and enhance organisational performances, thus proposing its acceptance and utilisation of its outcomes to better organisational performance.

Conflict Resolution strategies refer to particular behavioural patterns that a person prefers to employ when confronting a conflict situation (Rahim, 2002; Rahim et al., 2002; Ma, 2005). Among many models of conflict resolution strategy (Kilmann and Thomas, 1977; Rahim, 1983), the study considered the integrating style of Rahim's five types of interpersonal conflict handling model (Rahim, 1983). Rahim's five types of conflict handling styles, as shown in figure 1, consisted of five types: integrating, obliging, compromising, dominating, and avoiding based on two fundamental dimensions, i.e., concern for self (the extent to which a person attempts to satisfy own needs) and concern for others (the extent to which a person tries to satisfy others' needs).

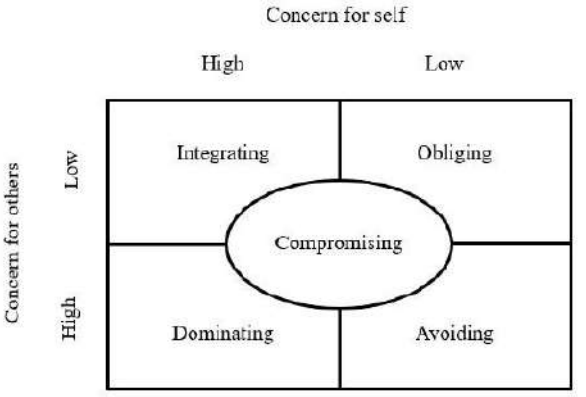

Figure 1: Rahim's five interpersonal conflict styles (Rahim, 1983, p.369)

Integrating style (a serious concern for self and others) attempts to satisfy the concerns of both parties and tries to achieve a win-win solution that is mutually beneficial for both parties (Robbins and Judge, 2013). The style involves openness, exchanging information, and examining differences to reach a practical, acceptable

solution for both parties. The integrating style is associated with another classification that demarcates conflicts into three domains, i.e., Task conflicts that relate to the content and goals of the work, Relationship conflicts that focus on interpersonal relationships, and Process conflicts that relate to how the work gets done (Robbins & 20 Judge, 2013). Research indicates that low levels of process conflict and low to moderate levels of task conflict can be functional, but any level of relationship conflict is dysfunctional all the time. These findings are not applicable in every context. It is important to note that many other factors may influence these functions, and thus collaborative management is needed. To reduce conflict by using collaboration rather than minimising organisational conflicts is the ultimate goal of problem-solving. (Antonioni, 1998). (Barbuto Jr and Xu, 2006). Problem-solving, collaboration, cooperation, solution-oriented, and win-win or positive-sum styles are other terms used to describe this approach. According to Gross and Guerrero (2000), the most accepted integrative style is appropriate, effective, and competent when resolving disputes.

Emotional Intelligence (EI)

Salovey and Mayer (1990), who propounded EI, define it as an individual's ability to recognise emotions of one's own and those of others in a manner that allows them to monitor them, distinguish among different emotions, and use this information effectively in shaping one's behaviour. Goleman (1998) identified EI under four dimensions of self-awareness, self-management, empathy, and social skill and defined it as the capacity to recognise our feelings and the feelings in others, motivate ourselves, and manage emotions well in us and our relationships. People who can recognise and monitor their feelings and can recognise and deal with the feelings of others have advantages in all areas of life. In contrast, those who cannot control their emotional lives constantly battle, preventing them from producing continued work and clear thoughts.

EI perspectives were different on the characteristics and dimensions, resulting in different interpretations by distinctive theorists. Wong and Law (2002) conceptualise the EI following Salovey and Mayor's (1990) in terms of four dimensions as self-emotional appraisal [SEA], others emotional appraisal [OEA], regulation of emotion [ROE], and use of emotion [UOE]. An escalating number of scholars suggest that EI has a considerable possibility of predicting workplace behaviour in organisations and contributing to understanding relationships in the work context (Salovey and Mayer, 1990; Goleman, 1998; Spielberger, 2004). individuals with well-developed EI can identify and control their own emotions and those of others. They are less likely to be paralysed by fear, hijacked by negative emotions, and strangled by anxiety, all of which negatively affect both individual and team performance (Lam and Kirby, 2002).

The link between EI and conflict is obvious. Human conflict does not exist in the absence of emotion (Jones, 2000). Conflicts are human behaviour, and they arise as a result of an emotional process. Bodtker and Jameson (2001) argue that if a person conflicts, he must be emotionally charged. One is not aware that one conflicts unless he recognises that he is emotional about something. Jordan and Troth (2002) have supported the same by exclaiming that it is naturally emotional if the conflict involves the perception of threats to individual goals. Similarly, Jordan and Troth (2004) put forward the notion that all conflicts (functional or dysfunctional) are intrinsically emotional since a conflict involves the perception of threat to an individual or a group. In light of the above findings, scholars argue that conflicts are inherently an emotionally created and driven process; thus, EI and conflict management are interconnected (Jordan and Troth, 2004; Eadie and Nelson, 2001; Bodtker and Jameson, 2001; Jones, 2000).

Understanding the role of emotions in conflict and conflict management is essential to manage them more effectively (Bodtker and Jameson, 2001). In the opinion of many academics, EI can play a critical role in effectively resolving conflicts (Jordan and Troth, 2002; Bodtker and Jameson, 2001). Those with a high level of EI can learn and use conflict management skills immediately in the workplace, solve conflicts faster and more effectively, have superior conflict resolution skills, and engage in greater collaboration. As a result, it contributes to better team performance (Cherniss and Adler, 2000; Desivilya and Yagil, 2005; Goleman,

1998; Jordan and Troth, 2004). Therefore, this study also presumes that EI may lead people to choose more advantageous styles of handling interpersonal conflicts. The selection of constructive conflict resolution styles indicates a high EI and vice versa.

Need for affiliation (nAff)

Human motivation is the psychological drive that guides a person towards achieving a goal, underlying reason for 'how' and 'why' people behave as they do (Hegar, 2012), account for an individual's intensity, direction, and persistence of effort toward attaining a goal (Robbins and Judge, 2013) which ultimately direct the behaviour (Mrayyan et al., 2008). The three prime motivational drivers identified are the need for achievement (nAch), the need for Power (nPow), and the need for affiliation (nAff) (McClelland, 1987). nAch drives a person to put his maximum effort to achieve the goals; do better, and aspire to a standard of excellence, nPow is the desire to control and influence others; to have responsibility for their performance; to have an impact on others (Uduji and Ankeli, 2013). nAff is to establish and maintain cordial relations with other humans; often choose to spend time with close friends or significant others and satisfy the need of having a personal relationship (Raeisi et al., 2012; Uduji and Ankeli, 2013). The importance of each of these needs varies from person to person (Lilly, Duffy, and Virick, 2006). Rybnicek, Bergner, and Gutschelhofer (2017) validated the same according to that study; the relevant brain area was more activated when there was a close matching of rewards with a person's need level (nAch, nAff, nPow).

When individuals are presented with rewards more closely to their desired needs, those rewards perceives as more rewarding (Schultheiss et al., 2008; Rybnicek et al., 2017).

A person with a fundamental need or desire to be with other people seek and grab the opportunities to interact with other people, and this is said to be driven by the nAff (McClelland, 1987). The definition for nAff is the desire for friendly and close interpersonal relationships such as spending more time maintaining social relationships, joining groups, and wanting to be loved (Ramlall, 2004), choosing to spend time with close friends or significant others rather than being in any other setting.

They are sensitive to others' reactions to them, prefer collaborative, non-competitive activities (Uduji and Ankeli, 2013), and exhibit substantial conformity to other people's wishes to maintain a friendly relationship (Lilly, Duffy, and Virick, 2006).

EI, nAff, and integrating style of conflict resolution

The study of Christie et al. (2007) revealed that people who have a higher ability to regulate their emotions were more likely to be motivated by achievement needs. Those who reported high in understanding others' emotions were motivated by affiliation needs. As claimed, conflict and human motivation are closely related concepts (Barbuto Jr and Xu, 2006). nAff positively correlated with the smoothing (cooperative) style (Jones and White, 1985). People with high EI interact well with people, possess good interpersonal skills (Goleman, 1998), and prefer collaborative conflict resolution styles (Jordan and Troth, 2002; Jordan and Troth, 2002a). Goleman (1998) suggested that individuals with high EI would have superior conflict resolution skills, engaging in greater collaboration. This assertion depends on the belief that individuals with high EI work to maintain relationships.

Similarly, McClelland (1987) proposes people who have affiliation motives seek social approval. This type of people typically desire to be fond of others and want others to like them, prefer to avoid conflict and competition with others (Lilly, Duffy, and Virick, 2006). They tend to elude problems arising from interpersonal incompatibilities and readily adjust their values or beliefs to others' to secure positive social relationships (Chatman and Barsade, 1995). According to the literature review, one can assume that there may be a complementing effect to an emotionally intelligent person driven with nAff, wanting to maintain a better relationship with others. That tends to select a more smooth conflict resolution strategy with a deep concern for their counterparties.

There are many studies available on EI and conflict resolution strategies (Ashkanasy and Daus, 2002; Bodtker and Jameson, 2001; Chan, Sit, and Lau, 2014; Di Fabio and Blustein, 2010; Jordan and Troth, 2004),

EI and human motivational needs (Christie et al., 2007; Jones and White, 1985; Essop, 2015) and human motivational needs and conflict resolution (Fodor, 1985; Bell and Blakeney, 1977).

As per the literature review, no study exists in searching for how nAff of individual influence on the established relationship of EI and integrating conflict resolution strategy within the Sri Lankan context. Thus this study attempts to bridge the said gap by analysing the moderating impact of nAff on the relationship between EI and integrating conflict resolution strategy.

Conceptual Model

In this study, EI is used to apply as an antecedent of integrating conflict resolution styles. The Affective Event Theory (AET) states that human behaviour drives emotions of human behaviour and conflicts (Jordan and Troth, 2004; Eadie and Nelson, 2001; Bodtker and Jameson, 2001).

Higher EI might generate a sympathetic feeling that encourages individuals to consider other interests when solving conflicts. In this situation, a win-win solution may become a priority in resolving the conflicts among individuals to satisfy everyone's interests. As a result, people with high emotional intelligence may prefer the integrating style. People with high nAff prefer to maintain social relationships, join groups, and want to be loved (Ramlall, 2004). They positively link with selecting smoothing conflict resolution styles (Jones and White, 1985). The integrating style is their preferred conflict resolution style because they are relationship-oriented. In order to conduct the study, nAff serves as a moderator.

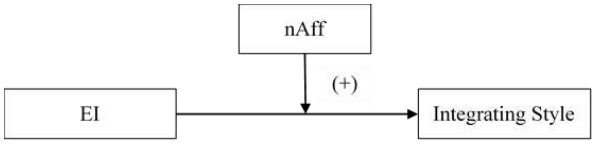

Figure 2: Conceptual Framework

The results of the studies consistently showed that individuals with high EI preferred to seek integrating solutions when confronted with conflict (Jordan and Troth, 2002; Jones, 2000; Shih and Susanto, 2010; Gross and Guerrero, 2000; Chan, Sit, and Lau, 2014). Integrating conflict resolution patterns is positively related to positive emotions and self-efficacy and a climate of concern for organisational interest (Jones, 2000). Goleman (1998) suggested that individuals with high EI would have superior conflict resolution skills. They can better negotiate and effectively handle affairs, using an integrative approach to develop new solutions to satisfy both parties' concerns. This assertion claims on the belief that individuals with high EI work to maintain relationships (Jordan and Troth, 2002). Emotionally intelligent people may more possibly consider other people's needs and interests in solving conflicts. Thus, a win-win solution produced by integrating style facilitates an opportunity to apply their concerns in resolving the conflicts among individuals to satisfy everyone's interests (Shih and Susanto, 2010). Further, emotionally intelligent people are more likely to select integrating and compromising styles because those styles may have more beneficial outcomes in terms of efficacy and suitability (Gross and Guerrero, 2000; Morrison, 2008). Based on the above arguments, they hypothesised that;

H1: EI is positively related to integrating conflict resolution strategy

nAff, nAch, and nPow are the three motivations that shape an employee's behaviour in an organisation, according to McClelland's human motivational need theory. People with high EI interact well with people and possess good interpersonal skills (Goleman, 1998). The people who have affiliation motive seek social approval and typically desire to be fond of others and want others to like them (Lilly, Duffy, and Virick, 2006). Also, nAff positively linked with preference to select the smoothing conflict resolution style (Jones and White, 1985). Thus there may be a complementing effect, so a person with high emotional intelligence who drives from affiliation needs to prefer an integrating conflict resolution style. That directs towards the concerning needs of the other party, attempting to satisfy the concerns of both parties and trying to achieve a win-win solution that is mutually beneficial for both parties (Robbins and Judge, 2013).

Synthesising the above literature, the researchers hypothesised that nAff would strengthen the positive relationship between EI and integrating conflict resolution style that focuses on high concern for others. The hypothesis developed :

H1a: NAff moderates the relationship between EI and integrating style

2. METHODOLOGY

The study employs a quantitative research technique, followed by a survey strategy and statistical analysis. It is a study with a positivist phenomenology.

The research was deductive as it started with examining the existing literature to establish a possible connection among the three key concepts of EI, nAff, and integrating conflict resolution style through testing established hypotheses. By exploiting the prevailing rich literature base, hypotheses are to be developed, tested, and confirmed.

The survey strategy used in this study attempts to explain what is happening in the social context and generalise the study findings. The study conducted a cross-sectional analysis using the collected data at a given time horizon only.

The study context was on Sri Lankan university undergraduates as there were many shreds of evidence on frequent student clashes and rivalry (Ruberu, 2003). Since university undergraduates are known to be the finest intellects who will be the prominent drivers of the country, addressing their critical behavioural issues seems obligatory.

The nature of the study aims to make statistical inferences of the population; thus, it is vital to select a representative sample. Therefore, the researchers used a convenience sampling (non-probability sampling) technique as it allowed the researcher ease of access to the respondents who enabled themselves to provide the desired information. This technique allowed the researcher to collect data at a lower cost and effort within a shorter duration despite the population scattered around the country.

A sample of 397 undergraduates covering all academic levels was selected representing certain universities to ensure the sample size's sufficiency (Krejcie and Morgan, 1970). The response rate was around 98 percent (388).

Table 1: Sample profile

Demographic Variable	Category	Frequency	
		Frequency	Percentage %
Gender	Male	62	16.0
	Female	326	84.0
Year	Year 1	11	2.8
	Year 2	65	16.8
	Year 3	154	39.7
	Year 4	158	40.7
University	CBO	27	7.0
	KLN	61	15.7
	PDN	2	0.5
	RUH	39	10.1
	SEUSL	3	0.8
	SJP	40	10.3
	SUSL	27	7.0
	UJA	26	6.7
	UWU	33	8.5
	WUSL	130	33.5
Degree	Agriculture	56	14.4
	BA	10	2.6
	BBA	17	4.4
	BBM	48	12.4
	BCom	13	3.4
	BSc - SCI	42	10.8
	BSc-MGT	188	48.5
	ICT	9	2.3
	Other	5	1.3

The primary data gathered from the sample of 388 students as the study's unit of analysis was individual undergraduate students.

Since the study adopted a survey strategy, data were collected using a self-administered Likert scale questionnaire. Table 1 shows a sample profile. Eighty-four percent of those polled were female undergraduates, and the majority of them were in their third or fourth year of study. The study used already developed and tested scales presented in table 2 to

enhance the validity and reliability of the research findings.

Table 2: Operationalization of the variables

Variable	Measurement
EI (Independent Variable)	Wong and law emotional intelligence scale (WLEIS) (1 = Strongly Disagree to 7 = Strongly Agree) (Wong and Law, 2002)
Integrating Style (Dependent Variable)	Rahim Organizational Conflict Inventory-II (ROCII) –Form C (1 = Strongly Disagree to 5 = Strongly Agree) (Rahim, 1983)
nAff (Moderator)	Unified Motive Scales (UMS) (1 = Strongly Disagree to 5 = Strongly Agree) (Schönbrodt and Gerstenberg, 2012)

3. RESULTS

The Pearson correlations performed provided a deeper analysis of the direction and strength of the nexus between EI, nAff, and integrating style of conflict resolution. Table 2 illustrates the correlation results.

Table 3: Correlation matrix of the relationship among variables. Source: Survey Data

	EI	Integrating Style
1 EI		
2 Integrating Style	.311**	
3 nAff	.238**	.269**

Note. N=388, **p< .01,
EI= Emotional Intelligence, nAff= Need for Affiliation
Source: Survey Data

Results indicate that, EI reported to have significant correlation with integrating style (r = .311, p < .01). nAff is significant and moderately associated with integrating style (r = .269, p< .01). A simple regression model was used to test the hypothesis using regression analysis based on the independent variable (EI) relationship with the dependent variable (integrating style).

The statistical model is as follows;

$$\mathbf{Y = b0 + b1X}$$

The model was used to determine whether or not there was a statistically significant link between EI and integrating style through a simple regression model. There was a statistically significant positive correlation between EI and integrating style (r =.311, p .01). The regression results are shown in Table 3.

Table 4. Hypothesis testing based on the regression model: EI and Integrating style

Model		Coefficient B	T	Significance
1	(Constant)	2.594	13.731	.000
	EI	.233	6.766	.000
R		.326***		
R^2		.106***		
F		45.773		
Predictors: (Constant), EI				
Dependent Variable: Integrating style				

*Note. N= 388, ***p< .001, EI=Emotional Intelligence*
Source: Survey Data

Table 5. Hierarchical regression: moderating effect of nAff on the relationship between EI and integrating style

Variable	Model 1	Model 2	Model 3
(Constant)	3.866 (192.969)	3.866 (196.818)	3.857 (192.585)
EI	.233*** (6.766)	.198*** (5.693)	202*** (5.826)
nAff	_	.158*** (4.076)	.161*** (4.162)
EI_X_nAff	_	_	.121* (2.082)
F	45.773	32.120	23.044
R^2	.106***	.143***	.153***
ΔR^2	_	037***	.010*
a. Predictors: (Constant), EI			
b. Predictors: (Constant), EI, nAff			
c. Predictors: (Constant), EI, nAff, EI_X_nAff			
d. Dependent Variable: Integrating Style			

*Note. * P<.05, ** P<.01, *** P<.001*
EI= Emotional Intelligence, nAff = Need for Affiliation
Source: Survey Data

The results of the regression model indicated that the predictor variable explains 11 percent (11%) of the variance in the outcome variable (R2= .106, F (1,386) = 45.773, p <.001). The results indicated that EI significantly predicts the selection of integrating style as a conflict resolution strategy (β =.233, p <.001). The two variables exhibit a significant positive relationship; hence the results of the research confirm hypothesis one (H1). Thus it concludes that EI is positively related to integrating conflict resolution style.

A key objective of this research was to ascertain how nAff moderates the relationship between EI and the integrating style of conflict resolution. When it comes to the relationship between emotional intelligence and the integrating conflict resolution style, that expects nAff to have a synergistic effect. Table 4 depicts the results, and the statistical model is as follows;

$$Y = b0 + b1X + b2Z + b3XZ$$

As shown in the table 4, the model indices in steps 1(F (1,386) = 45.773, p < .001), 2 (F (2,385) = 32.120, p < .001) and 3 (F (3,384) = 23.044, p < .001) are statistically significant. The model 1, 2 and 3 explains a variance of 11% (R2=.106, F (1,386) = 45.773, p<.001), 14% (R2=.143, F (2,385) = 32.120, p<.001) and 15% (R2=.153, F (3,384) = 23.044, p<.001) in the integrating style respectively. The statistical scores of the EI (β=.202, p < .001), nAff (β=.161, p < .001) and the interaction term (β=.121, p < .05) were significant. With the introduction of the interaction construct, the change of the R2 value was significant (ΔR2=0.010, p <0.05) indicating that there is potentially significant moderation between EI and nAff on integrating style (β = .121, p < .05).

Performing a simple slope analysis helps to identify the type of interaction effect. Students' nAff levels are represented graphically in Figure 3 by three simple regression lines: the low, average, and high values. Figure 3 illustrates the three simple regressions drawn to detect the type of interaction effect of the EI and nAff on selecting the integrating style with preference.

The graph demonstrates that an increase in EI was significantly associated with selecting an integrating style, and nAff enhanced this relationship. It confirms that high EI students driven with nAff have more preference to select integrating style to resolve conflicts. Consequently, the conclusion is that the model supports hypothesis H1a and proves a positive moderating effect of nAff on the relationship between EI and integrating style.

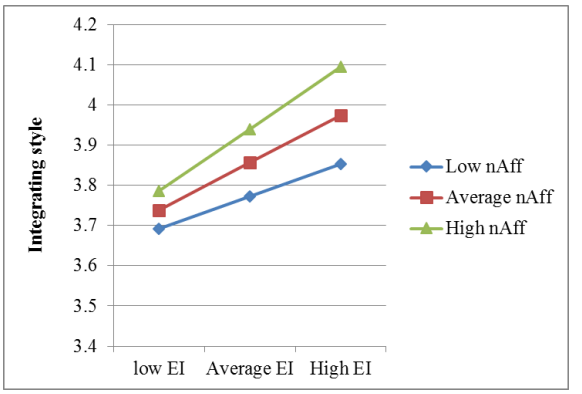

Figure 3: Moderating effects of nAff on the relationship between EI and integrating style
Source: survey data

4. DISCUSSION

The research proposed that nAff influences the students' decision of conflict resolution and their EI level. Referring to past literature, the influence of nAff as the moderating factor on the relationship between EI and integrating style, specifically concerning the context of Sri Lankan state university undergraduates, remained unexplored. It is vital to test the influence of the level of EI and the motivational drive of a person in selecting a conflict resolution strategy to have a more accurate purview in finding solutions to undergraduate conflicts. The study provides a comprehensive insight into the aforementioned field.

The statistical analysis results revealed that integrating style was preferred by most of the students, confirming Chan, Sit, and Lau (2014). This behaviour may be a result of the cultural values held by the students. The study of Morris et al. (1998) affirms that cultural values influence conflict management behaviour. Asian culture leans towards collectivism, where they value group goals over individual goals, group concerns over individual concerns, and collective needs over individual needs (Ting-Toomey et al., 1991).

In answer to the research question of whether emotional intelligence influences selecting Integrating conflict

resolution style, the outcomes concluded that EI is positively related to integrating conflict resolution styles. The findings confirm several other research findings (Jordan and Troth, 2002; Jones, 2000; Shih and Susanto, 2010; Gross and Guerrero, 2000; Chan, Sit, and Lau, 2014). People with higher emotional intelligence seek more collaborative solutions than those who lack emotional intelligence (Desivilya & Yagil, 2005; Jordan & Troth, 2002; Goleman, 1998). Integrating style is considered a more collaborative conflict resolution style (Gross & Guerrero, 2000; Morrison, 2008). These characteristics may lead students to always put other people's interests as an essential consideration in solving conflicts; thus, the styles which comply with those characteristics may have become a priority in the selection decision.

The second research question was whether the need for affiliation moderates the relationship between emotional intelligence and integrating conflict resolution style. Studies suggest that nAff positively links with selecting a smoothing conflict resolution style (Jones and White, 1985). And the results support the positive moderating effect of nAff on integrating style. It implies that if a person has a high EI level, they tend to select the integrating style. That association further strengthens if motivational affiliation needs to drive that person. People with high EI interact well with people and possess good interpersonal skills (Goleman, 1998). People with affiliation motives seek social approval and typically desire to be fond of others and want others to like them (Lilly, Duffy, and Virick, 2006). Thus the findings may result from the complementing effect of a high emotionally intelligent person who drives from affiliation need concerning other party's needs through attempting to satisfy the concerns of both parties. That tries to achieve a win-win solution that is mutually beneficial for both parties (Robbins and Judge, 2013), preferring an integrating conflict resolution style.

At the theoretical level, this research contributes significantly to understanding the role of nAff in defining the relationship between EI and the integrating style of conflict resolution. Prior researchers have investigated the direct association between EI and conflict resolution strategies; (Ashkanasy and Daus, 2002; Bodtker and Jameson, 2001; Chan, Sit, and Lau, 2014; Di Fabio and Blustein, 2010; Jordan and Troth, 2004), EI and human motivational needs (Christie et al., 2007; Jones and White, 1985; Essop, 2015) and human motivational needs and conflict resolution (Fodor, 1985; Bell and Blakeney, 1977). This research uniquely explores the relationship between EI and integrating style of conflict resolution strategies, with nAff modeled as the moderator.

The research concluded that nAff enhances the link between EI and integrating style of conflict resolution strategy. Therefore, it implies that to foster an environment to increase the chances of selecting a more productive and collaborative conflict resolution approach by a student, a higher EI would matter, and a drive for affiliation matters along with high EI

Studies have shown that integrating style leads to creative solutions and is generally perceived as the most appropriate, most effective, and highly competent style in managing conflicts. Studies have revealed that a higher level of EI would direct people to select more collaborative conflict resolution styles (Antonioni, 1998; Ashkanasy and Daus, 2002; Bodtker and Jameson, 2001; Chan, Sit, and Lau, 2014; Di Fabio and Blustein, 2010; Jordan and Troth, 2004; Gross and Guerrero, 2000). According to this study, when students' EI and affiliation drives get stimulated, they are more likely to choose effective conflict resolution methods like integrating style. Thus one of the practical implications of this study is to elevate the level of emotional intelligence of the students. In the initial stage of the university academic life, the university system can introduce programs to elevate the students' level of emotional intelligence. The outcome of these programmes would help them to select more appropriate and productive conflict resolution styles.

The study also found that by increasing the students' level of emotional intelligence and stimulating their affiliation drives, they can select more productive conflict resolution approaches such as integrating style. Therefore, giving them opportunities to enhance the affiliation with EI development programmes under University Grants Commission before the student are enrolled to the universities (i.e., secondary education level and induction level) would yield better results.

5. CONCLUSION

The outcomes concluded that EI is positively related to integrating conflict resolution styles. However, the research outcomes need examination in the light of several cautions to put the findings in perspective.

These limitations can potentially impact the generalisability of the research outcomes beyond the context of the present research. The study sample was limited to state university undergraduates, employed a non-probability sampling technique that acquires data using convenience sampling. In terms of the survey methodology, this research relied on self-reported data. Given the nature of the acquired data, the possibility of self-report bias may occur. Moreover, the model only examines a fraction of human motivational needs, EI, and conflict resolution strategies where other unmeasured factors such as personality, values, and culture could influence. Future researchers could address the limitations mentioned above and direct their studies to address the remaining gaps.

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TRAGEDY OF WOMANHOOD WITHIN PATRIARCHY: AN ANALYSIS OF GENDER AND SEXUALITIES IN IBSEN'S A DOLL'S HOUSE

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ABSTRACT

A Doll's House (1879) by Henrik Ibsen (1828 - 1906) is a play that follows the trajectory of Nora, a woman belonging to the 19th century Norwegian society, who has been forced to stifle her vibrant personality to survive within a male dominated system. Ibsen successfully presents an authentic glimpse of life through the experiences of a woman who is beginning to realize the suppression she has been subjected to as a result of the rigid understandings of gender and sexualities perpetuated through patriarchal ideologies. This play becomes an ideal platform to examine how women are governed by socially prescribed identities that destroy their agency and freedom. The main research problem addressed in this study is whether gender and sexualities are discursive constructions that oppress and marginalise women within the patriarchal social structure. The idea of performativity introduced by Judith Butler is used as the central framework through which this idea is explored. Moreover, feminist theories presented by Simone de Beauvoir, Helene Cixous, bell hooks, Gilbert and Gubar will also be referred to within the research to support the arguments formulated. A textual analysis of the play was conducted to explore the fluidity and artificiality of the concepts of gender and sexuality. Accordingly, the central findings of the research highlighted the fact that gender and sexuality are discursive constructions that relegate women into marginal positions. This qualitative study will contribute towards the understanding of gender and sexuality as social and cultural productions that sustain hegemonic ideologies and power hierarchies.

KEYWORDS: *A Doll's House, Ibsen, Gender, Sexuality, Performativity, Patriarchy*

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1. INTRODUCTION

A Doll's House (1879) by Henrik Ibsen (1828 - 1906) is a well-made play that explores complex facets of gender and sexual identities. As a playwright, Ibsen is heavily influenced by Naturalism that stresses the need to capture the reality of daily life, human behaviour, actions, and relationships. His plays reveal an attempt to present the audience with a "slice of life" (crossref-it.info, 2021, p. 1) through which they can understand and analyse their own lives. In this drive to explore human nature through his work, Ibsen addresses many issues faced by women in his contemporary society. Set in 19th century Norwegian society, this play provides a glimpse of the discriminatory practices of patriarchy that marginalise and oppress women. Nora in *A Doll's House* (1879) is a woman trapped within her socially imposed role and is forced to endure an oppressive marital life while suppressing her desires. She is a vivacious woman who is forced to smother her sexuality, creativity and energetic nature to survive within a patriarchal society. Nora's trajectory is reflective of social norms and expectations that function upon the basis of gender and sexuality. She lives in a society where women are marginal characters within the larger political, social and economic spheres that operate under patriarchal ideologies. Women who dared to stray from these rigid boundaries were chastised and ostracized from society.

Walby (1990) defines patriarchy "as a system of social structures and practices in which men dominate, oppress and exploit women" (Walby, 1990. p. 20). This oppression is rooted in the representation of women as inferior to that of their male counterparts. These conventional understandings of womanhood and femininity can be further discussed through the concepts of sex and gender. Traditionally, as mentioned in the text *Gender Trouble* (1990) by Judith Butler, 'sex' was regarded as an essential, biological and natural aspect that is pre-determined and fixed, whereas gender is the acquired cultural and social values by which men and women function. Hence, gender identities are assigned according to the anatomical differences between men and women. Butler (2006) is critical of this dichotomous distinction between the sexes as it becomes the primary source through which gender roles and sexual desire are regulated. Accordingly, she argues that "gender is the cultural interpretation of sex" (Butler, 2006, p. 10). This argument is further developed by showing how "sex is as culturally constructed as gender" (Butler, 2006, p. 9). This understanding is used as the central framework within which the play *A Doll's House* (1879) has been analysed in this research. Although, this play has been previously analysed within a feminist framework, the existing research does not adequately address whether gender and sexualities are discursive constructions. Furthermore, how patriarchal ideologies perpetuate rigid definitions of gender and sexualities that acclimatize women into peripheral positions has not been discussed in depth. This is the research gap the current study attempts to fill.

2. METHODOLOGY

A textual analysis of the drama *A Doll's House* (1879) by Henrik Ibsen was conducted based on a subjective ontological perspective. The main research problem addressed in this research is whether the concepts of gender and sexual identities are discursive constructions that marginalise and oppress women within the patriarchal social system. This idea is examined in light of how Nora, the female protagonist of *A Doll's House* (1879) becomes a victim of rigid societal conditions that aim to restrict and discriminate women. This research is a non-positivist and qualitative study that is based on the ontological assumption that the concepts of gender and sexuality are constructed through hegemonic discourses and power hierarchies. Moreover, it is assumed that these gender and sexual identities are fluid and multifaceted. A constructivist epistemological stance has been adopted to understand how the concepts of gender and sexuality are subjectively experienced and constructed. A feminist theoretical framework has been used to analyse the various nuances of gender and sexuality that can be highlighted in the play *A Doll's House* (1879). The theories of Judith Butler, Simone de Beauvoir, Helene Cixous, bell hooks, Gilbert and Gubar are some of the central concepts referred to within the research. The ideas of performativity, construction of gender, reclaiming agency over mind and body, marginality as a site of resistance, dichotomized readings of womanhood presented by these theorists will be given focus in this study. The setting, historical context,

dialogues, actions, stage directions, character portrayals and the plot-line of this drama were analysed to formulate interpretations and understand the dominant discourses and hierarchies that construct notions of gender and sexuality within the patriarchal social system.

3. RESULTS

This research elucidates how gender and sexualities are discursive constructions that marginalise and oppress women within a patriarchal social structure. Butler's main argument of how "there is no 'natural body' that pre-exists its cultural inscription" (Salih, 2006, p. 55) reflects how gender and sexualities are constructed by society and are therefore, determined by cultural and social norms. This idea is addressed through Nora's gradual realisation of how she has been conditioned to perform the conventional role of a woman. She is marginalised and oppressed by patriarchal ideologies that exercise control over women's minds and bodies to sustain dominance over them. Her trajectory is reflective of the possibility for women to perform their gender and sexual identities differently. Hence, it further elucidates how these discursive constructions of gendered identities and sexualities are fluid and changeable. This drama reverberates the opportunity for women to break free from the socially inscribed values that ensnare them within conservative roles and ideals of womanhood.

4. DISCUSSION

Nora is a victim of institutionalised forms of marginalization that are designed to oppress women and contain them within their roles as daughters, wives and mothers. At the beginning of the play, Nora appears to fit into the ideals of a Victorian woman. She is a doting wife and a loving mother to her children. She is only expected to bear the responsibility of maintaining the household and to remain submissive to her husband. Words such as "my little lark" and "my little squirrel" (Ibsen, 1879, p. 6) that Torvald uses to address Nora show how she is infantilised and treated as someone who constantly needs his guidance in life because she is a woman. Furthermore, these pet names are reflective of Torvald's sense of superiority over Nora. He considers Nora to be nothing more than a possession or a 'doll' to be 'played' with, rather than an equal partner in marriage. The animal imagery used in the dialogues intensifies the dehumanizing treatment suffered by Nora within the household where she is seen "as less than human, a mere pet he owns" (Lavender, 2008, p. 122). Interestingly, Nora too responds to this demeaning treatment by playing the role of an ignorant, timid wife in order to feed Torvald's ego. The concept of performativity discussed by Judith Butler (2006) becomes applicable to the way in which Nora performs the role of a Victorian woman. As Butler argues, "gender is the repeated stylization of the body, a set of repeated acts within a highly rigid regulatory frame that congeal over time to produce the appearance of substance, of a natural sort of being" (Butler, 2006, p. 45). Nora has been conditioned into 'being' a woman through repetitive practices of her gender role that society has imposed on her. Her submissive behaviour is considered as the norm or as something that is 'natural' due to the fact it is in accordance with the regulations or beliefs of society. Hence, Nora's character is representative of culturally constructed identities and gender performances that mould one into a 'woman'. This idea can be linked to Simone de Beauvoir's argument that "one is not born, but rather becomes, [a] woman" (1947, p. 330). Thus, Nora too 'becomes' a woman by being subjected to social values, practices and norms perpetuated to maintain patriarchal dominance. She suppresses her 'true' character in order to identify with the socially constructed image of a woman. This highlights how gender is a discursive construction that oppresses women within an androcentric social structure. It is her behaviour, monologues or her relationships with Mrs. Linde, Doctor Rank and Krogstad that bring out the complexity of her character which is hidden behind the facade she maintains to please Torvald and society. As the play progresses, Nora finds the agency to construct her own identity that is free from societal pressures and expectations. As Salih mentions, the concept of agency was of central importance to Butler because "it signifies the opportunities for subverting the law against itself for radical, political ends" (Salih, 2006, p. 55). Nora redefines her status as a woman by 'subverting the law' of her contemporary society that discriminated and oppressed women based on discursively constructed gender biases. She starts forming her own individuality by saying "I must stand quite alone, if I am to

understand myself and everything about me" (Ibsen, 1879, p. 203). This is a moment that radicalized 19th century theatre by depicting women as strong, independent characters. This can also be linked to the idea of situated freedom through which Simone de Beauvoir "seeks to theorize women's situation as constituting the struggle with the pervasive idea that motherhood constitutes women's personal and psychological fulfillment." (Marso, 2012, p. 1). Accordingly, Nora's struggle to find freedom is inhibited by this 'situation' where motherhood is equated with womanhood and individual desires are only allowed to exist within the confines of her socially prescribed gender role. However, triggered by her gradual disillusionment, Nora begins to question the inferior position she has been assigned within the household and the larger society for the first time in her life. It is an important step that helps Nora become an individual who has the freedom and ability to think and act on her own. Hence, she ventures beyond her socially constructed self to explore her own identity as a woman and as a human being.

The idea of gender performance is brought to an almost tangible level through the references to the Tarantella and the rehearsals prior to the party. This also marks a climatic moment in the plot where the idea of Nora emerging out of the conventional image of a woman is captured. The mythical references to the fatal bite of the Tarantula spider which was believed to cause an extreme restlessness that would eventually lead to death, becomes symbolic of the impending catastrophic change in Nora's life. The instance where she dances to the fast, upbeat tempo that is characteristic of the Tarantella dance is a significant moment through which Ibsen provides a glimpse into Nora's inner psyche. The lack of a set rhythm and the chaotic movements become metaphorical of how Nora is trying to go against the pattern of social behavior prescribed for her. Nora is a woman who is struggling to understand her position in society as a woman. She gradually realizes the oppressive nature of her marital relationship and how her personal desires have been smothered by social conventions. This conflict between the self and the society can be analysed based on Gilbert and Gubar's theory of the two antithetic identities that society has attributed to women. Within the limited world women can inhabit they are given two options; "if they do not behave like angels they must be monsters" (Gilbert and Gubar, 1979, p. 43). Nora has been conditioned to repress her creativity, dreams and aspirations to behave according to patriarchal social expectations. Her suffering is reflective of how women have been framed within conventional roles that destroy their agency and freedom. Moreover, Nora's actions are imbued with sexual connotations that elucidate how she is exploring her sexuality as a woman which has been cruelly stifled by patriarchal ideologies. As Cixous (1976) also highlights, the vibrant sexualities and desires of women have been suppressed due to feelings of guilt, fear and shame that are instilled by the male-dominated system to prevent women from "mak[ing] trouble" (p. 876). The way in which women have been robbed of their own bodies and sexualities is highlighted when Cixous states that patriarchy has ingrained a "stupid sexual modesty" (1976, p. 885) in women to prevent them from establishing an identity that is free from societal regulations. Nora too has been conditioned by these ideas of gender and sexuality. However, this moment becomes a significant instance that marks the unravelling of Nora's character. The way in which she temporarily strays from socially ascribed gender roles and expectations by continuing her frenzied dancing metaphorically shows how she stops being an 'angel', and thereby becomes a 'monster' in the eyes of society. Torvald is shocked by his wife's breach of social decorum as evident when he exclaims "stop... this is sheer madness. Stop, I tell you" (Ibsen, 1879, p. 147). Torvald's reaction is symbolic of how the patriarchal social structure aims to control or chastise women who venture beyond their social roles. Torvald makes a desperate attempt to control Nora, but she directly refuses to heed his advice for the first time in the drama. This is suggestive of how Nora is beginning to establish her authority within the household and the larger society by defying longstanding norms and conventions.

Moreover, the way in which Nora uses this dance to convey her emotions points to the absence of a discourse for women to articulate and express their own oppression. It is the only mode through which she can release her frustrations of having to live her life within a rigid framework of social norms. Nora's wild and frantic movements are reflective of her inner emotional turmoil which is hidden beneath the facade of a timid, mild-mannered Victorian wife. The fatality associated

with the term Tarantella is also suggestive of a dance of death. Nora performs this dance as her final moment of uninhibited self-expression and creativity. Her anxieties over the revelation of her secret, her emotions and the vibrant energy that she was forced to repress are powerfully released through this moment. As Torvald says, Nora is "dancing as if her life depended on it" (Ibsen, 1879, p. 147). Ironically, it is Nora's performance that delays Torvald from discovering her secret. Hence, her future does depend on her actions that prevent Torvald from reading Krogstadt's letter that will bring about a massive change to their lives. Furthermore, it is also interesting to note how any emotional expression is brought out through some sort of performance within the play. Ibsen (1879) uses such dramatic and powerful bursts of energy or actions as a tool through which the psychological dimensions of his characters can be understood. For example, this Tarantella dance and the rehearsals are representative of the tormented interior of Nora's character. Her actions are quite contrary to the image of a submissive wife she attempts to uphold. Similarly, in the drama Hedda Gabler, Ibsen juxtaposes the image of the guns and the piano to bring out Hedda's conflict with the gender norms inscribed on her by society. The piano which is generally associated with femininity is used by Hedda as an expression of relentless power and violence. She releases her pent up energy and frustrations by playing the piano in a wild and chaotic manner. This can be linked to Butler's argument of how "gender is always a doing" (Butler, 2006, p. 34). The actions of dancing and playing the piano can be understood as part of their gender performance. However, these ruptures within their socially prescribed roles as exemplified through the actions of Nora and Hedda reflect how women can 'do' gender differently (Butler, 2006). Ibsen attempts to show how women are human beings above all else. It is only upon Nora's realisation of who she is as a human being that can then embody the other aspects of her gender identity she may choose to embrace. Therefore, this play is a powerful embodiment of the artificiality of gender identities and sexualities which relegate women into marginal positions while positioning men in the centre.

Furthermore, the concept of the home and Victorian domesticity is rooted in the representation of women as domestic beings. Women are seen as the epitome of the moral, social and material image of the home. Nora becomes the idealized version of the middle class Victorian woman by acting as the self-sacrificial, caring wife and mother while fulfilling household responsibilities and maintaining the material respectability of the home. She is "under a cultural compulsion to become one" (Butler, 2006, p. 11) to blend into the patriarchal structure that is governed by strict demarcations of gender. Women are acclimatized into their marginal positions by men so that they can continue their dominance over women. As Cixous (1976) argues,

> Men have committed the greatest crime against women. Insidiously, violently, they have led them to hate women, to be their enemies, to mobilize their immense strength against themselves, to be the executants of their virile needs. They have made for women an antinarcissism! A narcissism which loves itself only to be loved for what women haven't got! (p. 878)

The voice and agency of women have been discarded for generations by brainwashing them into accepting their subordination. This 'antinarcissim' has prevented women from embracing their own lives, bodies and minds. Women have been alienated within their homes, their relationships with other women have been destroyed, their needs and desires have been smothered. The policing of their bodies as well as their minds are powerfully captured through the instance where Torvald is sexually aroused by Nora after the Tarantella performance and demands that she attend to his desires. Providing sexual gratification is seen as a part of her duty as a woman and a wife. Hence, it is clear that Nora's ownership of her own body is limited and her own sexual needs are not recognized. The way in which Torvald forbids her from eating macaroons or asks her to dress as a "Neapolitan fisher-girl" (Ibsen, 1879, p.92) for the party are also examples of how he exercises power over Nora's body. Thus, Nora's plight as a woman within a repressive environment that functions upon rigid gender and sexual demarcations is made evident. Additionally, the concept of a home is governed by dichotomized readings of masculinity and femininity. This "masculine/feminine binary" (Butler, 2006, p. 6) can be seen as a dominant factor that

influences societal perceptions of how men and women should function. Nora is constantly seen within the drawing room where ideals of Victorian womanhood are played out while Torvald occupies his office, a space that is symbolic of work, achievement and manhood. Thus, the private sphere of the home is represented by Nora and the public sphere is represented by Torvald. This spatial reading becomes important to understand the way in which Nora dismantles these boundaries by walking out of her marriage. The stage directions of the door being slammed shut at the end of the play is a powerful moment that symbolizes the fracturing of this dichotomy. Nora enters a sphere that is forbidden for her because she is a woman. Her journey is therefore, representative of the historical transition of the domesticated Victorian woman into the New Woman. At the onset of the play, Nora is aware yet uncritical of her domesticated position within the household. It is only after the secret of their debt to Krogstad is revealed that she understands how their marriage depends on her being under the complete authority of her husband. This is what allows Nora to understand the importance of agency and propels her desire to break free from the oppression. The instance where Torvald says that Nora is an unfit mother who can no longer be trusted with the upbringing of her children marks the shattering of the illusion of Torvald's love for her. She then realizes the extent to which she has been oppressed and discriminated throughout her life. This "pattern of domination" (hooks, 1984, p.26) is evident when Nora says, "our home has been nothing but a playroom, I have been your doll-wife, just as at home I was Papa's doll-child; and here the children have been my dolls" (Ibsen, 1879, p.201). This highlights how women were treated as objects within the Victorian society. The lifelessness, lack of control and fragility associated with the image of a doll is reflective of the way in which Nora is toyed with or exploited by those around her. The concept of the New Woman challenged these perceptions by giving the understanding that women strive for a sense of fulfillment and independence as opposed to adhering to conventional stereotypes. Thus, Nora rebels against her socially constructed gender identity in order to form one that is free from oppression.

Nora directly challenges the social structure that is governed by patriarchal ideologies and power hierarchies. This becomes a central mode through which her transition into the New Woman occurs. In commenting about the play, Ibsen himself wrote that "a woman cannot be herself in contemporary society. It is an exclusively male society with laws drafted by men and with counsel and judges who judge feminine conduct from a male point of view" (Joyce, 2016, p. 1). Social constructs such as religion and law that are supposed to exist for the betterment of people are detrimental to their existence. This is made evident through the fact that women were not allowed to borrow money without the consent of a man. Nora is driven to take extreme measures in order to save her husbands' life and once again falls prey to the manipulative control of a man; Mr. Krogstad. Nora is disillusioned when she realizes that "the law cares nothing about motives" (Ibsen, 1879, p.74). Her utter helplessness is made clear when her husband, Torvald says that what Nora has done by going against the legal and moral expectations of society makes her "a criminal" (Ibsen, 1879, p. 188). Nora is forced to acknowledge the fact that her position as a woman within their household and the larger society is controlled and shaped by deeply rooted patriarchal ideologies. Moreover, financial independence was a major aspect of the image of the emerging New Woman that is in direct contrast to the domesticated, dependent woman of the Victorian context. Nora is willing to lose her status, financial support and her family in order to form an identity for herself. The fact that she rejects any financial or material help offered by Torvald by stressing that there should be "perfect freedom on both sides" (Ibsen, 1879, p. 214) is reflective of the extent to which she desires to be liberated from the oppression she was subjected to throughout her life. It is this massive sacrifice and courage presented through the trajectory of Nora that makes the play so profound and radical. This becomes one of the reasons for *A Doll's House* (1879) to be considered as *"*one of the ground-breaking modern literary texts that established in fundamental ways the responsibility and cost of women's liberation and gender equality" (Mambrol, 2020, p. 1). Furthermore, Ibsen (1879) also discusses the idea of choice by highlighting how women are only presented with very few possibilities of transforming their oppressive

conditions. Nora is restricted even within her opportunities to choose a different lifestyle. Nora decides to leave her marriage and family within a context where women are left helpless without the support of a man, either the husband or the father. She does so within a society that is preoccupied with social status and money. Her choice of leaving her home and her marriage is fused with the threat of social chastisement, unemployment and alienation. This highlights the tragedy of womanhood with a patriarchal society governed by rigid constructions of gender identities and sexualities. The normative behaviour expected from women based on patriarchal constructions of gender and sexualities frames women like Nora within an oppressive structure that destroys freedom and individuality.

Nora's disillusionment of her position as a woman in the 19th century Norwegian society becomes a powerful platform through which Ibsen voices the detrimental effects of following strict social codes and practices. The events that unfold with the gradual realisation of her dependency and helplessness pave the way for Nora to take control of her own life. Gender and sexuality become concepts that are constructed in a way that marginalises women and locates them in the periphery, while their male-counterpart always remains at the center. However, the way in which Nora regains authority over herself is reflective of the idea that the marginal position she occupies in her society has been transformed by her into "a site of radical possibility, a space of resistance" (hooks, 1990, p. 341) through which she can challenge dominant patriarchal ideologies. Nora deciding to leave her husband, her children and her home was not only a shocking moment in European theatre, but also an important point that pushed society towards understanding the need to break free from tradition. The notion that a woman was able to reject the identity imposed by society and embark on a journey to find herself was almost unthinkable in a society that vehemently depended upon convention. Nora steps beyond her role as a wife and a mother by realizing that she has "other duties just as sacred" (Ibsen, 1879, p. 205). This liberal standpoint that emphasizes individual freedom is a key characteristic of the emerging New Woman. It directly opposes the hegemonic constructions of gender norms and sexual identities that have been imposed upon women by patriarchy. Ibsen (1879) seems to uphold and perpetuate feminist ideologies through his plays as seen through how Nora finds the courage to construct her own identity by defying what society expects from her as a woman. Although this may have not been the original intention of writing the play, Ibsen addresses the issue of individual freedom and the existential crisis experienced by people during the late 19th century which resonated with the emerging concepts of female independence and gender equality. Therefore, while *A Doll's House* (1879) becomes a radial play that brings forth feminist ideologies, Ibsen also focuses on issues beyond the position of women in society. As Lavender (2008) argues,

> If Ibsen gives us in *A Doll's House* his first fully realized heroine, he also proclaims through the exploration of her psychology what he feels to be intrinsic and necessary to the life of the true human being: freedom (p. 9).

The identity of human beings, the complexity of their relationships, their trajectories are aspects that are highlighted in his plays and the need for "freedom" lies at the core of Ibsen's work. Therefore, the transformation of Nora from being a woman without a sense of individuality into an independent person who yearns to be true to herself can be understood through these elements discussed by Ibsen (1879). Thus, the liberation of the self from social barriers was seen as a central mode through which a woman could break free from the generational oppression that aimed to control and suppress women. Reclaiming agency over mind and body becomes essential for Nora to emancipate herself from social restraints. can perform her gender and sexuality differently while challenging the artificially constructed identities imposed by the patriarchal social structure that aims to discriminate women.

5. CONCLUSION

In conclusion, *A Doll's House* (1879) by Ibsen is a play that radicalizes the position of women in society by focusing on the transformation of Nora from a timid, domesticated woman into a woman who yearns to be independent and true to herself. Nora's courageous act of leaving her home, her husband and children to find

herself becomes a symbol of the possibility for women to achieve liberation from oppressive power structures and social constructs. Her actions are in direct defiance of the patriarchal values and norms that were practiced during this period. The conventional interpretations of gender and sexuality have been dismantled through the revolutionary actions of Nora in shedding her socially prescribed identity. Hence, this is a play that marks the emergence of the New Woman where the oppressive Victorian ideals of womanhood are challenged and eliminated. The character of Nora is representative of the struggle for female independence and empowerment that paved the way for the historical transition of women from being generic family members into becoming individuals. Thus, the subordinate position women were compelled to inhabit within a patriarchal social structure is questioned by interrogating the artificiality of gender and sexualities.

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FOOD AND FEEDING HABITS OF WILD GUPPY (*Poecilia reticulata*), IN NATURAL WATER BODIES OF SRI JAYEWARDENEPURA CANAL SYSTEM, SRI LANKA

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ABSTRACT

Guppy (Poecilia reticulata) is a small freshwater fish belonging to the family Poeciliidae, first introduced to Sri Lanka in 1928 and used to control malaria mosquito vectors during1940-1950. The present study investigates the food and feeding habits of wild guppy. The six locations identified for sampling between January 2016 and December 2017 were: Attidiya, Bellanwila, Rattanapitiya, Nawala, near Parliament Grounds, and Jayewardenepura Hospital. Once a month, water and fish samples were collected from each sampling site and sent to the lab for analysis (n=216; n=2160). The researcher measured the Total Length (TL), Total Width (TW), and the weight of fish with an accuracy limit of 1mm and 0.1mg, respectively. Under the microscope, the food items in the dissected stomach were identified using the standard keys and counted using a Sedgewick-Rafter cell to calculate the percentages.

Female fishes were larger than males, and the average mean of body length value was 24.56 ± 5.46 mm (range: 15-35 mm) in females and 20.19 ± 2.75 mm (range: 15.0-24.5 mm) in males. Mean body weight of females and males were recorded as 0.174 ± 0.105 g (range: 0.026- 0.382 g) and 0.075 ± 0.021g (0.024- 0.11 g) respectively. Guppy has consumed most of the food items available in water (freshwater debris). Their feeds mainly consisted of freshwater debris (41%), phytoplankton (24 %), zooplankton (21 %), unidentified insect parts (12%), and adult mosquito parts (2%). The guppy is an omnivore, and in the wild, they feed on a combination of animal and plant-based meals.

KEYWORDS: *Poecilia reticulata, Omnivorous, Gut contents, Food habits, Natural water bodies.*

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1. INTRODUCTION

Poecilia reticulata is a small freshwater fish belonging to the family Poeciliidae, first introduced to Sri Lanka in 1928 and used to control malaria mosquito vector during 1940-1950 (Silva and Kurukulasuriya 2010). Males appear smaller than their females. Males reach up to 4 cm in length while females grow up to 6 cm (Pethiyagoda, 1991). They are distributed all over Sri Lanka and well established across North-Western, Western and Southern provinces (Weerasinghe, 2008; Bambaradeniya, 2008; Gunawardena, 2008). They inhabit various aquatic habitats such as streams, marshes, paddy fields, and polluted waterways (Pethiyagoda 1991; Edirisinghe and De Alwis 2012). *P. reticulate* is considered an invasive species in Sri Lanka (Silva and Kurukulasuriya 2010).

According to the preliminary studies, *P. reticulata* (Guppy) and *Gambusia affinis* (Mosquitofish) are abundant in the Sri Jayewardenepura canal system, one of the oldest canal systems in Sri Lanka located in a highly urbanized, highly polluted area (Edirisinghe and De Alwis 2012). The present study investigated the food and feeding habits of the Guppy, *P. reticulata*, to provide valuable information in rational exploitation and aquaculture management of the species.

Many investigators used the stomach contents of fish to determine their feeding habits (Hyslop, 1980). The development of successful capture-and-culture fisheries worldwide depends on fish nutrition and feeding habits (Adebisi, 1981; Blay and Eyeson, 1982).

According to Ndome and Victor (2002), the correct usage of fish species for fish culture, ornamental purpose, and larval control requires basic information on the feeding ecology of the fish. *P. reticulata* was widely used in the past to control mosquitoes. It is a popular ornamental fish due to its diverse colour patterns. They are very attractive fish, making them a veritable export product and foreign exchange earner (McKay, 1984; Allen *et al*., 2002).

2. METHODS

Study Area

The present study covers six selected locations (covering three sampling points in each location) in Colombo, the Sri Jayewardenepura canal system, and part of the Diyawanna Oya canal network. It is a man-made canal system located on the left bank of the lower valley of Kelani Ganga and situated in the western province, Colombo district of Sri Lanka, latitudes 6^0 52’ 55” - $6^0$55’ 45” N and longitudes 79^0 52’ 35” – 79^0 55’ 15” E (Figure. 1).

The average depth of the canal system is about 1.5m (CEA 1995). It may vary seasonally due to heavy sedimentation of silt and bank erosion in the rainy season. It gets frequently clogged with floating weeds & dumps (polythene, plastics & domestic wastes (CEA 1995). The present study covers approximately 15km of the canal network. Six locations and the sampling points at each location (Table 1) were selected considering environmental factors (such as the abundance of aquatic vegetation, water flow rate, water depth, etc.) and the occurrence of *P. reticulata* populations.

Table 1: Study locations and GPS coordinates.

Location	GPS coordinates
Location 1. Attidiya	6^0 83’ 72” N, 79^0 89’ 03” E
Location 2. Bellanwilla	6^0 84’ 59” N, 79^0 89’ 41” E
Location 3. Rattanapitiya	6^0 85’ 30” N, 79^0 89’ 89” E
Location 4. Nawala	6^0 88’ 23” N, 79^0 88’ 43”E
Location 5. Near Parliament ground	6^0 89’ 36”, N 79^0 91’ 81” E
Location 6. Near Jayewardenepura hospital road	6^0 86’ 65” N, 79^0 93’ 05” E

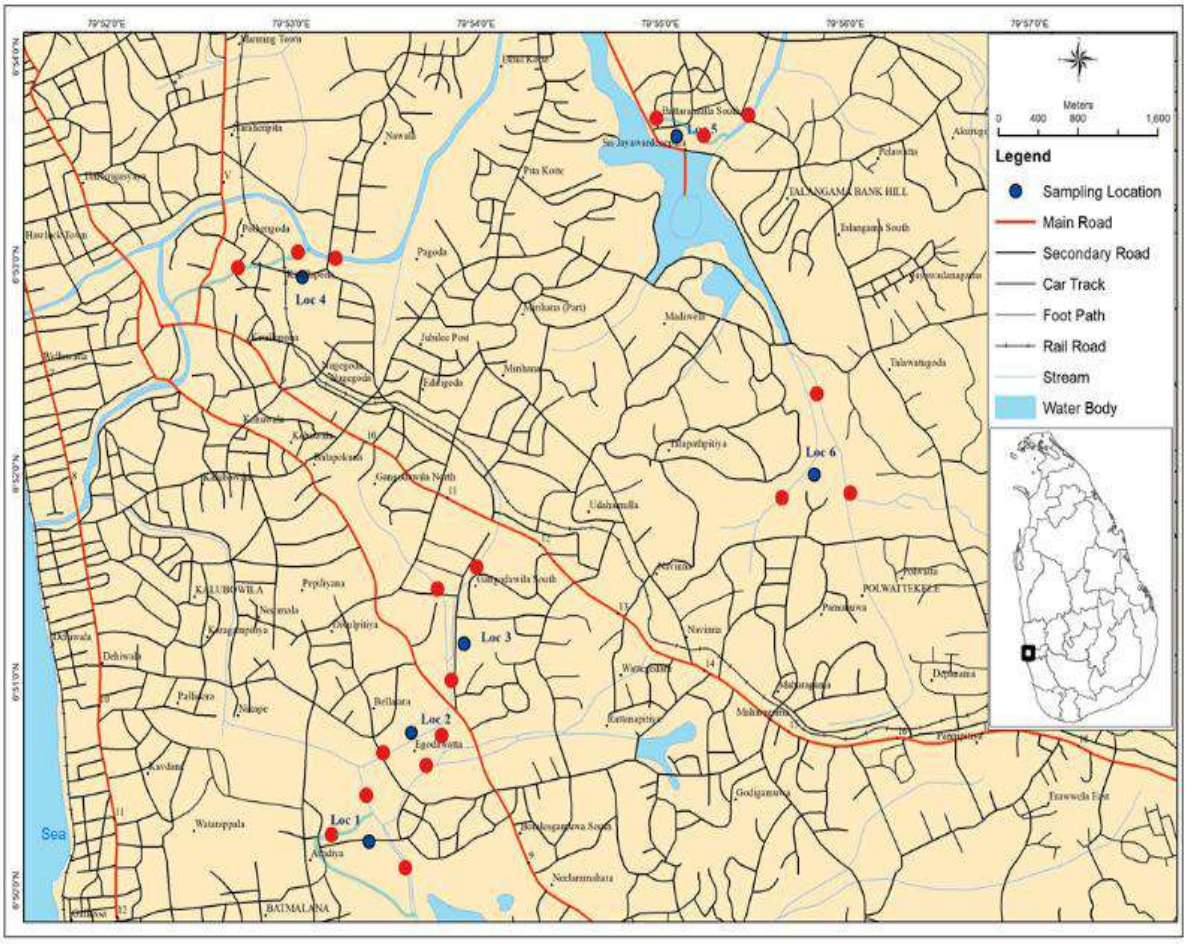

Figure 1: Study locations (in blue) and sampling points (in red) in the Colombo-Sri Jayewardenepura canal system

The sampling method of fish

P. reticulata (guppy) was present in all sites investigated during field visits subsequently identified as wild populations. Fish were separated according to their sex and counted. Representative samples were immediately preserved in properly labeled plastic bottles using 5% formaldehyde and brought to the laboratory. During the study period, the researcher analyzed randomly selected fish (n= 2160).

Total lengths (TL) and total weights (TW) of fish measured nearest to 0.1 cm and TW to the nearest 0.1mg). At significance levels (p 0.05), a nonparametric Mann-Whitney U test assisted in comparing body weight and length between males and females. During the dissection, the stomach and the uncoiled intestine were cut-opened, and their contents emptied into a Petri dish. The stomach and gut contents dissolved in 5 ml of water and 1 ml of solvent were transferred into Sedgewick-Rafter cell and examined under the binocular microscope. The appropriate keys helped to identify the food items (Needham and Needham, 1962; Wimpenny, 1966; Whitford and Schmacher, 1973; Schneider, 1990). The following equation aided in calculating the percentages of food items in 1 ml of dissolved gut content after counting the food items (Thomas, 1997; Harris, 2012 Phan et al., 2015).

$$\text{Percentage (\%) of food item per 1 ml} = \frac{\text{Number of particular food item counted} \times 100}{\text{Total number of food items counted}}$$

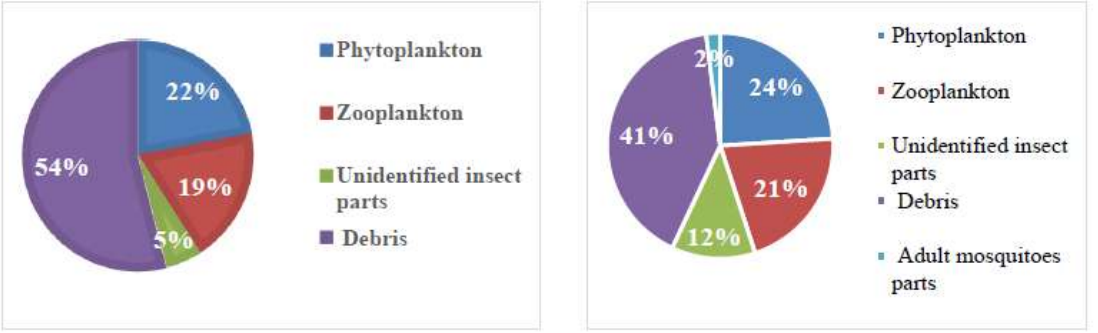

Figure 2: (a) Percentage (%) of food items in the water in study locations, (b) Percentage (%) of food items in the gut contents of *P. reticulata*

Sampling of plankton

During the investigation period, the Zooplankton and phytoplankton samples (n-216) collected from each sampling site (n-18) in each location on each sampling day aided in analyzing the plankton composition in the waters.

In each site, 20 liters of water filtered through a 55-micron plankton net were used to collect plankton. Collected plankton samples were preserved in labeled plastic bottles by adding Lugol's solution (1% concentration) and kept for 24 hours to settle. Enumeration and microscopic identification were performed at the laboratory under a binocular light microscope at x4 and x10 magnifications with calibrated eyepiece using a Sedgwick rafter counting chamber (Chittapunet *et al*., 2009). Magnus Live USB 2.0 camera aided to capture Images for further identification. Standard plankton identification guides assisted in identifying Plankton species (Thomas, 1997, Harris, 2012; Phan et al., 2015;).

3. RESULTS

Lengths, weight, and relative abundance of wild guppy

The relative abundance of females was always higher than that of males. Relative densities of females were roughly twice that of the males and approximately 2:1 female: male ratio, which is evident in all locations.

According to Mann-Whitney U test comparisons results, there was a significant sexual dimorphism in body weight and length ($p = 0.000$ in both cases), indicating females being larger than males. The average Mean body length was 24.56 ± 5.46 mm (range: 15-35 mm) in females and 20.19 ± 2.75 mm (range: 15.0-24.5 mm) in males. The Mean body weight in females was 0.174 ± 0.105 g (range: 0.026-0.382 g) in comparison with 0.075 ± 0.021g (0.024-0.11 g) in males.

Food and feeding habits of wild guppy

Figure.2 (a) represents the percentages of different food items consumed by *P. reticulata*. The summary of stomach contents of *P. reticulata* is presented in Figure 2 (b), which indicates the percentage (%) of food items in the surrounding water. The types of food in the water included phytoplankton (22%), zooplankton (19%), unidentified insect parts (5%), and debris (54%). The highest percentage was debris (Figure 2 a). However, there were no larval stages of mosquitoes in the water samples. According to the food items consumed by *P. reticulata*, the highest percentage was debris (41%), followed by phytoplankton (24%), zooplankton (21%), unidentified insect parts (12%), and adult mosquito parts (2%) as illustrated in Figure.2 (b).

Table 2: Species composition of phytoplankton and zooplankton in water at the study locations, in gut contents of *P. reticulata*

Group	Phylum	Genus/ Description	Availability in water	Availability in gut contents of *P.reticulata*
Phytoplankton	Chlorophyta	*Elakatothrix* sp	√	√
		Closterium sp.	√	√
		Cosmarium sp.	√	√
		Volvox sp	√	x
	Bacillariophyta	*Melosira* sp.	√	√
		Stephanodiscus sp	√	x
	Dinoflagellata	*Peridinium* sp.	√	√
	Euglenozoa	*Phacus* sp.	√	√
		Euglena sp.	√	√
	Cyanobacteria	*Lyngbya* sp.	√	√
		Oscillatoria sp	√	x
		Chroococcus sp	√	x
Zooplankton	Arthropods	Copepod nauplii	√	√
		Lecane sp	√	√
		Trichotria sp	√	√
		Asplanchna sp,	√	x
		Brachionus sp	√	x
		Colurella sp	√	x
		Proalinopsis sp	√	x
		Daphnia sp	√	√

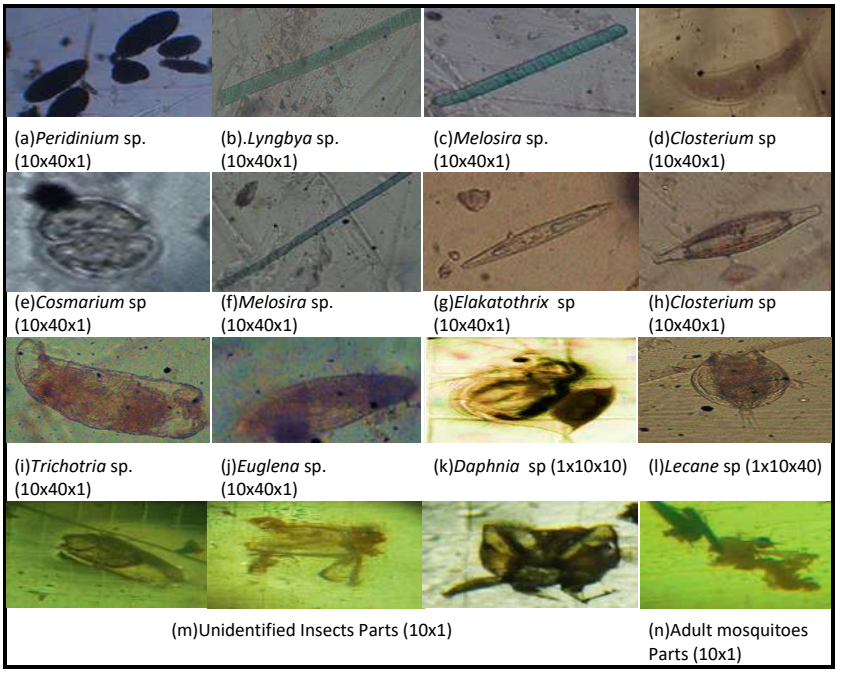

Plate 1: Common species of phytoplankton, zooplankton, and other food items were recorded of *P. reticulata* gut contains.

There were no mosquito larvae observed in the gut contents. The presence of adult mosquito parts contained within the identified insect parts indicates their role in consuming mosquitoes. The guppy is an omnivore: feeding on animal and plant-based meals.

Table 2 further analyses the composition of phytoplankton and zooplankton in the waters of the study locations. The gut contents of *P. reticulata* (Plate 1) show common phytoplankton, zooplankton, and other food items recorded in their gut contents.

The phytoplankton in water contained genera such as *Elakatothrix* sp., *Closterium* sp., *Cosmarium* sp., *Volvox* sp., *Melosira* sp., *Stephanodiscus* sp., *Peridinium* sp., *Phacus* sp., *Euglena* sp., *Lyngbya* sp., *Oscillatoria* sp., and *Chroococcus* sp. The zooplankton in water consisted of genera such as Copepod nauplii, *Lecane* sp. *Trichotria* sp., *Asplanchna* sp., *Brachionus* sp., *Colurella* sp., *Proalinopsis* sp., *Daphnia* sp. (Table 2). *P. reticulata* have consumed most of the species available in water (Plate 1).

4. DISCUSSION

The present study recorded a female-biased sexual dimorphism for *P. reticulata* wild population. Females' mean length and weight were consistently higher than those of males for wild populations in the Sri Jayewardenepura canal system. Relative densities of females were roughly twice that of the males, and an approximately 2:1 female: male ratio is evident in all locations. However, (Sterba 1983; Hernandez *et al*., 2004) have reported different results for the same species. Nikolsky (1963) confirmed that the sex ratio might vary between populations of the same species and in the same population during different periods. While the degree of dimorphism was similar in both studies, (Sterba 1983) has recorded a maximum body length of 60 mm for females and approximately 30 mm for males, while (Hernández *et al*., 2004) recorded a maximum body length of 51.1 mm for females, and 30 mm for males. The maximum length values recorded in the present study for females and males were well below those reported by (Sterba. 1983 and Hernández *et al*., 2004).

The size range of collected specimens of *P. reticulata* investigated in the present study was 15 - 35 mm. Their feed consisted mainly of phytoplankton, zooplankton adult mosquitoes, unidentified insect parts, and freshwater debris. Lawan *et al.,* 2012, reported the stomach contents of guppy, *P. reticulata*, were categorized into eight groups. Algae, diatoms, protozoan, mosquito larvae, fish parts, crustaceans, organic detritus, and sand grains. The major food item of *P. reticulata* examined during this study was green algae, with *Ulothrix* sp. being the most preferred alga. Introducing mosquito fish also can reduce algal blooms in waters. As the fish eat mosquitoes, that will help to reduce the mosquito problem to a certain extent. They feed on zooplankton grazers (Hurlbert *et al.,* 1972). The fish eat the invertebrate predators (Hoy *et al.,* 1972, Bence, 1988). *P. reticulata* is omnivorous, feeding on algae (approximately 50% of the wild diet), invertebrate larvae, and benthic detritus (Dussault and Kramer, 1981). Within their natural range, they may also prey on larvae of their species and of other fish. Houde, 1997 reported that *Poecilia gills* feed on detritus, diatoms, and filamentous algae, and *P. reticulata* also feeds on fish parts, zooplankton, and detritus (Winemiller 1993). This observation equally agreed with Arthington (1989) and Rodriguez (1997), who reported similar results for other guppy species elsewhere. The present study results indicated that they do not play any role as mosquito larvivorous fish. Still, their feed is mainly freshwater debris, phytoplankton, and zooplankton in the Sri Jayewardenepura canal system. However, the data indicates that they may contribute to mosquito control as they have consumed a small percentage of adult mosquitoes. More sampling locations and sites are in progress to confirm these findings.

5. CONCLUSIONS

The results revealed that while the *P. reticulata* population is well-established in the canal system,

they maintain a dominant female population. Their feed consisted of the highest percentage of debris (41%), followed by phytoplankton (24%), zooplankton (21%), unidentified insect parts (12%), and adult mosquitoes' parts (2%). Guppy has consumed most of the food items available in the water. The guppy is omnivorous and, in the wild, takes in a combination of animal and a plant-based diet.

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IMPACT OF COVID-19 ON US DOLLAR EXCHANGE RATE IN SRI LANKA: A TIME SERIES ANALYSIS

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ABSTRACT

The exchange rate is considered a key financial variable that affects the decisions of exporters, importers, investors, bankers, tourists, and policymakers in developed and developing countries. Exchange rate fluctuations determine the international reserves, international investment portfolios, the competitiveness of exports and imports, and the costs incurred by tourists. Understanding the behaviour of exchange rates is important for developed and developing countries to formulate and modify economic policies. Therefore, this research studies the influence of COVID-19 on the USD sell exchange rate in Sri Lanka using a time series analysis. The study was conducted using daily exchange rates from 19 November 2019 to 18 October 2020, and it attempted to obtain the best ARIMA model: AR(1), AR(6), AR(14), AR(27), MA(3), MA(8), MA(11). Finally, the USD sell exchange rate has been forecasted from16 October 2019 to 31 January 2021.

KEYWORDS: *Time series forecasting, Covid-19, ARIMA, Exchange rate, Sri Lanka, Pandemic*

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1. INTRODUCTION

The coronavirus that caused the COVID-19 epidemic originated in Wuhan, China. At present, it has engulfed nearly the whole world, causing unimaginable loss of lives and economic uncertainties. Most countries face economic disputes because they maintain lockdowns and island-wide curfews to tackle the spread of the virus (Wetsman, 2020). As a result of the unstable economy, businesses are primarily concerned with surviving. Therefore, investors are not encouraged to invest, and they stock money to face future uncertainties. This situation will increase the USD sell exchange rate because of low supply and high demand for USD. The Coronavirus pandemic has adversely affected the countries excessively relying on exports and experiencing debt burdens. The countries facing debt burdens are adversely affected due to the severe coercion on foreign exchanges leading to currency devaluation. Since Sri Lanka is a small open economy, fluctuations in exchange rates directly affect domestic price levels and international trade (Central Bank of Sri Lanka, 2006). USD sell exchange rate in Sri Lankan felled to the value of Rs.200.00 for the first time in history on the 8th of April 2020.

Since a country's exchange rates are considered a key financial variable that plays a significant role in the economy, a timely forecast of movements in the exchange rates is required (Rao & Sahoo, 2020). Analysing the exchange rate movements is essential to provide useful statistical information to the stakeholders participating nationally and internationally (Rao & Sahoo, 2020). Therefore, this study illustrates US Dollar sales exchange rates in Sri Lanka during the impact of the COVID-19 outbreak by utilising a time series data analysis with the help of EViews software.

2. LITERATURE REVIEW

COVID-19 impacts the economy by resulting in unemployment and the devaluation of currency (Yilmazkuday, 2020). Because catastrophes are inherently unexpected, it is difficult to depend entirely on the accuracy and trustworthiness of predictions in such circumstances. Also, disease outbreak is an alternative channel of exchange rate behaviour (Iyke, 2020). The impact of the present global pandemic COVID-19 on the exchange rates in Papua New Guinea was difficult to assess since the country has been experiencing a lack of US Dollars since 2016 (Odhuno, 2020). Using time-series data analysis, Dineri et al. (2020) investigated the correlation between the number of COVID-19 cases and fatalities and the exchange rate. After conducting the cointegration test, they identified no significant relationship between new cases, deaths, and exchange rates. According to Dineri & Çütçü (2020), the reason for the increase in the exchange rate in Turkey was mainly due to the negative consequences of the country's economic uncertainty during the pandemic. Indonesia has experienced a decrease in exports and an increase in imports during the pandemic period, which has caused a decrease in foreign exchange reserves. Indonesia has imported personnel protection equipment and medicine related to coronavirus (Catherine, Zaini, & Angelia, 2020). The main reason for the burst in the US Dollar exchange rate was the investors' panic behaviour due to the COVID-19 outbreak.

Furthermore, global uncertainty creates issues for the assets of the investors in financial and capital markets. The study shows a direct relationship between Covid 19 and Rupiah exchange rate. Greater the number of causalities weaker the Indonesian Rupiah exchange rate with the US Dollar. Finally, the study has suggested reducing imports and exports to increase the Rupiah Exchange rate by enhancing foreign exchange reserves (Catherine, Zaini, & Angelia, 2020).

A Generalised Auto-Regressive Conditional Heteroskedasticity (GARCH) model and a feedforward neural network using the backpropagation algorithm as ANN model, Nanayakkara, Chandrasekaran, and Jayasundara (2014) forecasted the daily currency exchange rate of the US dollar versus Sri Lankan rupee. Ayekple et al. (2015) performed a time series analysis of the exchange rates of Ghanaian Cedi against US Dollars. They carried it out by implying Random Walk (RW)

Model and ARIMA model. In this study, the exchange rates had become nonstationary. Therefore, the researchers had used first differencing to convert nonstationary into stationary. Box-Jenkins model was used to find out the most suitable model for forecasting. In order to find the Box Jenkins model, ACF and a sample PACF were used, and it helped to characterise the stationary time series. Ayekple et al. (2015) highlighted that the Box -Jenkins three-stage procedure of selecting a proper ARIMA model could be applied to derive accurate and reliable estimations and predictions for a univariate time series. The three stages were namely (i) identification, (ii) estimation, and (iii) diagnostic checking stage. Ayekple et al. (2015) have employed the least square method to estimate the parameters of the model developed to analyse the USD exchange rates in Ghana. Ogbonna (2018) applied the ARIMA model for modeling the daily USD sell exchange rate in Nigeria from 2016 to 2017. The study results showed that ARIMA (0, 1, 1) with a constant value (0.3171) is considered the most suitable model. Augmented Dickey-Fuller test (ADF) and Philips-Perron test (PP) aided in checking whether the time series is stationary or nonstationary. Autocorrelation and partial autocorrelation functions helped to identify the best suited ARIMA model. The Ljung Box test evaluated the model's accuracy (Ogbonna, 2018). Zeleke (2014) has examined the monthly average USD exchange rate in Rwanda with the help of the Box and Jenkins approach from the beginning of 2003 to the end of 2012. According to the study, out of the Auto-Regressive model (AR), Moving Average model (MA), and Autoregressive Moving Average model (ARMA), which was the most suitable model to examine the average Rwanda Francs against US Dollars. The exchange rate depreciation was mainly due to the decrease in exports and increase in imports in Rwanda.

Gupta & Pradeep (2018) studied the behaviour of the daily USD exchange rate in India between 20 March 2003 to 20 April 2018. EMDs, ACFs, PACS, Support Vector Regression, Neural Networks, and Additive Regression were studied and compared to determine the best method for estimating the exchange rate. According to the study, the results gathered from SVR and linear regression provide much better results than Neural networks. The results obtained from the ARIMA model were not satisfactory, but the amount of error caused by the ARIMA model was low (Gupta & Pradeep, 2018). Al Sameeh & Sayed (2020) has forecasted the USD exchange rate in Sudan using the ARIMA model. The research has used ADF, correlogram, and ARIMA to fit the best model for modelling and forecasting the exchange rate. After the initial differencing, both the ADF and the correlogram for the exchange rate data became stationary. After examining the model's selection criteria, the research had concluded that ARIMA (1,1,0) is the best model to forecast exchange rate data in Sudan. Further, Al Sameeh & Sayed (2020) mentioned that the Box-Jenkins approach is more appropriate for modeling and forecasting exchange rates. Mihaela (2012) has stated that predictions based on the AR model generate overestimated exchange rates, and it is one of the major deficiencies of the ARIMA model. Moreover, the researcher has recommended the Diebold-Mariano test to assess predictive accuracy. Although several studies on how politics, war, natural disasters, etc. impact USD exchange rates, there were few studies on how pandemics affect USD exchange rates. COVID-19 epidemic significantly impacts the USD exchange rate in Sri Lanka. However, a lack of study still examines the impact of COVID-19 on US Dollar exchange rates in Sri Lanka. Therefore, this study attempts to fulfill the gap by examining the impact of COVID19 on USD exchange rates in Sri Lanka by utilising time-series data analysis techniques.

3. METHODOLOGY

For the research, the Central Bank of Sri Lanka provided daily US dollar exchange rates from November 19, 2019, to October 18, 2020. ARIMA model, with the help of EViews software, conducted the time series analysis and forecasting. Various assumptions are needed while doing a time series analysis: the time-series variance and mean stay are constant throughout the period, the error term distribution is random, and the variance and means are constant at a specific time. Before doing a time

series analysis and forecasting, it is necessary to complete the following steps: determine seasonality, stationarity, model identification, diagnostics, and residual analysis (Khalid, 2020). Also, it is important to visualise the time series data since it helps to identify the structural breaks and the seasonality of the time series (Erica, 2019). Box-Jenkins ARIMA and Vector Autoregressive models are frequently used for time series analysis across the globe (Erica, 2019). Therefore, in this study ARIMA method was used to analyse and forecast the time series. Time-series graphs help to visualize how the daily USD sell exchange rates are deviating against Sri Lankan Rupee values and identify the seasonality and stationarity. A regressions analysis by EViews derived coefficient, volatility, adjusted r-squared, AIC, and SBIC.

The first step in conducting a time series analysis and forecasting is to test for the seasonality of the time series. Seasonality can be defined as periodic fluctuations or patterns that repeat within a period (Markoulis, Katsikides, & Hassapis, 2019). The purpose of the seasonality test is to check for seasonal movements in a time series and conclude whether to adjust it or not (JDemetra, 2020). Straight after conducting the seasonality test, a stationarity test was conducted. The term stationary defines constant mean and variation throughout the series. Moreover, stationary becomes beneficial since predicting the future using past observations (Jebb et al. (, 2015). In order to determine if a time series is stationary or not, the ADF test is the most frequent unit root test that one can be used (Chaudhary, 2020). The unit root test is a test of stationarity (or nonstationary) that has become widely well-known over the past several years. Before doing an ARIMA analysis, it is necessary to transform data into a stationary state. De-trending is necessary if the data are trending (Ngozi, 2018). In the ADF test, if the mean and the autocovariance of the time series data do not depend on time, it is identified as stationary. If any series is not stationary, it is nonstationary or unit root. The ADF test is very important in time series analysis because the standard assumptions will not be valid if the model is not stationary (unit root). ARIMA's time series forecasting relies on stationary data (Chaudhary, 2020). In order to undertake an ARIMA approach (also known as a Box Jenkin's model), the first step is to determine what kind of model is needed. Autoregressive Integrated Moving Average (ARIMA) model is the widely used forecasting model to predict time series. ARIMA is capable of analysing different standard temporal structures in time series data. It defines a particular time series based on past values using its lags and lag forecasting errors (Loukas, 2020). Using the Autocorrelation plots and the Partial autocorrelation plots can identify the Auto-Regressive (AR) and Moving Average (MA) parameters that are to be used to build the model (Khalid, 2020).

Partial autocorrelation yields AR parameters. The partial autocorrelation summarises the connection between data in a time series and previous observations, ignoring the intervening observations (Brownlee, 2017). AR use observations gained from previous time steps as inputs for the regression equation to predict the amount at the next time step (Brownlee, 2017). Autocorrelation creates MA parameters. The degree of similarity among the relevant time series data and a lagged version of the relevant time series data over consecutive time intervals are represented mathematically by the autocorrelation. Instead of using two contrasting time series, autocorrelation uses a lagged version of the same time series. The relationship between the variable's past and current values can also be measured using autocorrelation (Smith, 2020). Averages calculated using the sequential segment data points of the time series values are the MA parameters (Frost, 2020). After choosing the suitable ARIMA model and before running the time series forecasting, a diagnostic test must be conducted to determine whether any AR and MA values have been left out. This step determines whether the model suits the data, estimates residual, captures Autocorrelation Function and Partial Autocorrelation Function residual, and applies a diagnostic test to validate the model and select the best among other models (Marilena, 2015).

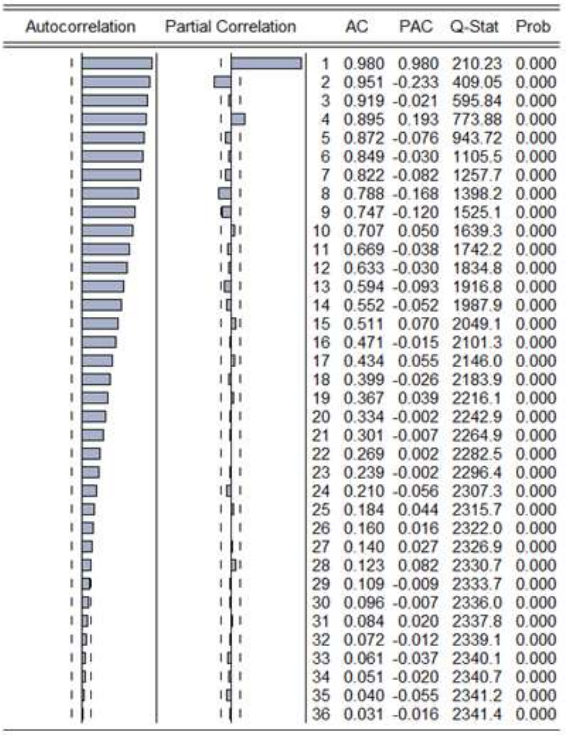
Determining whether the residuals estimated for

models are white noise is considered as one of the simplest forms of choosing a model (Marilena, 2015). Moreover, supposing it has been estimated as white noise, it could be accepted unless there would be autocorrelation of errors which need a return to the identification stage and rectify the error by adding several lags (Marilena, 2015). Residual diagnostic test and the Ljung–Box test are the main methods used to conduct the model diagnostic test for the ARIMA method. Residuals in time series are used to verify whether the model has adequately captured relevant information while analysing what has been left out after fitting a model (Hyndman, 2018). The residuals' autocorrelations might be used to show the correlogram perspective of the residuals (University of Washington, 1997). Furthermore, residuals could be derived by the difference between the actual and the fitted value of the dependent variable. Therefore, it signals likely errors that the regression might experience during forecasting (University of Washington, 1997).

The Ljung - Box test, also known as modified Box-Pierce, or the Box test, is used to test the absence of serial autocorrelation, up to a particular lag (Glen, 2018). The test is used to determine whether errors were white noise or not and whether it has more reason behind them. Also, to check whether autocorrelations for the errors or residuals were nonzero (Glen, 2018), forecasting is used as a technique that uses past data as inputs to predict the future direction (Tuovila, 2020). The ARIMA forecasting model had gained wide popularity because of its reliability and success in forecasting (Gujarati, 2009). Validity can be measured as external or measurement validity and is mainly focused on concluding on whether the findings of the research are really as they appear to be. It is required to compute the validity of the measurement to recognise what has been assumed to measure.

4. DATA ANALYSIS

A correlogram determines whether the study is seasonal or nonseasonal. In order to get a summary of correlation between two time periods, a correlogram may be used (Glen, 2016).



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.980	0.980	210.23	0.000
		2	0.951	-0.233	409.05	0.000
		3	0.919	-0.021	595.84	0.000
		4	0.895	0.193	773.88	0.000
		5	0.872	-0.076	943.72	0.000
		6	0.849	-0.030	1105.5	0.000
		7	0.822	-0.082	1257.7	0.000
		8	0.788	-0.168	1398.2	0.000
		9	0.747	-0.120	1525.1	0.000
		10	0.707	0.050	1639.3	0.000
		11	0.669	-0.038	1742.2	0.000
		12	0.633	-0.030	1834.8	0.000
		13	0.594	-0.093	1916.8	0.000
		14	0.552	-0.052	1987.9	0.000
		15	0.511	0.070	2049.1	0.000
		16	0.471	-0.015	2101.3	0.000
		17	0.434	0.055	2146.0	0.000
		18	0.399	-0.026	2183.9	0.000
		19	0.367	0.039	2216.1	0.000
		20	0.334	-0.002	2242.9	0.000
		21	0.301	-0.007	2264.9	0.000
		22	0.269	0.002	2282.5	0.000
		23	0.239	-0.002	2296.4	0.000
		24	0.210	-0.056	2307.3	0.000
		25	0.184	0.044	2315.7	0.000
		26	0.160	0.016	2322.0	0.000
		27	0.140	0.027	2326.9	0.000
		28	0.123	0.082	2330.7	0.000
		29	0.109	-0.009	2333.7	0.000
		30	0.096	-0.007	2336.0	0.000
		31	0.084	0.020	2337.8	0.000
		32	0.072	-0.012	2339.1	0.000
		33	0.061	-0.037	2340.1	0.000
		34	0.051	-0.020	2340.7	0.000
		35	0.040	-0.055	2341.2	0.000
		36	0.031	-0.016	2341.4	0.000

Figure 1: Correlogram for USD sell exchange rate
Source: Data library of the Central Bank of Sri Lanka (2020)

Figure 1 represents the correlogram for the USD sell exchange rate. If the inputted time series is seasonal, the autocorrelation plot will display repeating patterns with lags moving up and down (Corrie, 2015). The gradual decline of the autocorrelation represents nonstationary time series. A correlogram should be developed using the difference to make it

stationary (Chekwas, 2020). According to Figure 1, there is no such pattern shown by the autocorrelation containing 36 lags. Therefore, the time series is considered nonseasonal.

Table 1: ADF test results for USD sell exchange rate
Source: Compiled by authors (2020)

			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-1.709328	0.4251
Test critical values:	1% level		-3.461178	
	5% level		-2.874997	
	10% level		-2.574019	
*MacKinnon (1996) one-sided p-values.				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
SER(-1)	-0.019618	0.011477	-1.709328	0.0889
D(SER(-1))	0.282296	0.066607	4.238229	0.0000
D(SER(-2))	0.071691	0.069393	1.033117	0.3028
D(SER(-3))	-0.253000	0.066922	-3.780497	0.0002
C	3.691844	2.147316	1.719283	0.0871
R-squared	0.154122	Mean dependent var		0.025133
Adjusted R-squared	0.137777	S.D. dependent var		0.692004
S.E. of regression	0.642567	Akaike info criterion		1.976610
Sum squared resid	85.46865	Schwarz criterion		2.055775
Log likelihood	-204.5207	Hannan-Quinn criteria.		2.008607
F-statistic	9.429057	Durbin-Watson stat		1.923240
Prob(F-statistic)	0.000001			

According to Table 1, the term Durbin Watson stat calculates the serial correlation in the residuals. Akaike Info Criteria (AIC) is used as a model selection criterion for "non-nested alternatives." AIC with minimum value has been chosen to select the most suitable ARIMA model for example, selecting the smallest value of AIC would help to choose the length of the lag distribution. Schwarz Criterion could be used as an alternative to the AIC (EViews, 2019). Hannan-Quinn Criterion (HQ) could also be considered a penalty function that imposes a larger penalty for additional coefficients, same as Schwartz Criterion. F-statistic is a form of a testing hypothesis, and it has been used when all the slope coefficients under regression are zero (excluding the intercept and coefficient) (EViews, 2019).

Augmented Dickey-Fuller (ADF) test was utilised to conduct the stationarity test. Table 1 represents the ADF test results. According to the results, the Augmented Dickey-Fuller Test Statistic is -1.709328 Here, the absolute value is considered and the sign is not considered. If the absolute value was lower than the critical test value, the test could not reject the null hypothesis. Also, if the probability value is less than 5%, the null hypothesis can be rejected (Inani, 2015). According to the above calculation, the estimated probability value of 0.4251 was higher compared to 0.05. Therefore, the results have concluded that the time series SER has a unit root. Therefore, it could be concluded that the series is not stationary. According to (Fuhad & Jahanara, 2019) ADF test is accurate and reliable for determining the nature of the data. Further, they have recommended using first differencing to convert nonstationary time series into stationary time series.

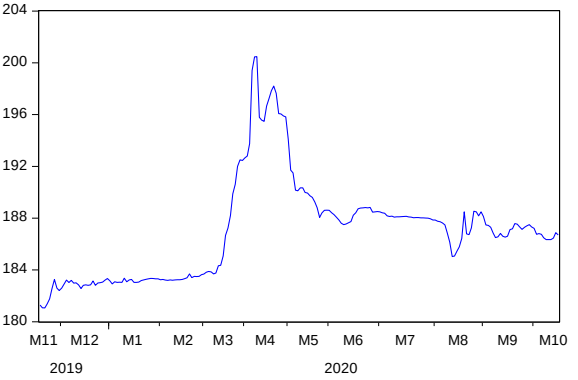


Figure 2: USD sell exchange rate
Source: Data library of the Central Bank of Sri Lanka (2020)

Figure 2 illustrates the graphical representation of the USD sell exchange rate in the form of nonstationary time series. The ADF test was conducted at its first difference to make the time series stationary.

Table 2: ADF test results at its first difference Source: Compiled by authors (2020)

			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-9.807431	0.0000
Test critical values:	1% level		-3.461178	
	5% level		-2.874997	
	10% level		-2.574019	
*MacKinnon (1996) one-sided p-values.				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(SER(-1))	-0.921266	0.093936	-9.807431	0.0000
D(SER(-1),2)	0.200193	0.082346	2.431124	0.0159
D(SER(-2),2)	0.264056	0.066916	3.946089	0.0001
C	0.022155	0.044401	0.498981	0.6183
R-squared	0.405213	Mean dependent var		-0.002314
Adjusted R-squared	0.396634	S.D. dependent var		0.831046
S.E. of regression	0.645528	Akaike info criterion		1.981193
Sum squared resid	86.67504	Schwarz criterion		2.044524
Log likelihood	-206.0064	Hannan-Quinn criter.		2.006790
F-statistic	47.23502	Durbin-Watson stat		1.925540
Prob(F-statistic)	0.000000			

A similar method was used by Fuhad & Jahanara (2019) and Sameeh & Sayed (2020). They had used ADF, correlogram, and ARIMA to fit a suitable model for modelling and forecasting time series.

According to Table 2, the absolute value of the ADF test statistic is 9.807431, and it is higher than the critical test value of 3.461178. Also, the probability value is less than 0.05. Therefore, it can be concluded that the time series is stationary.

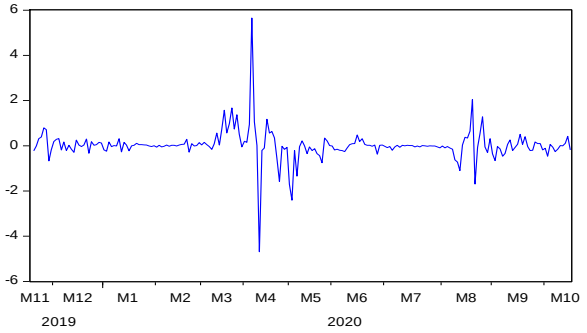
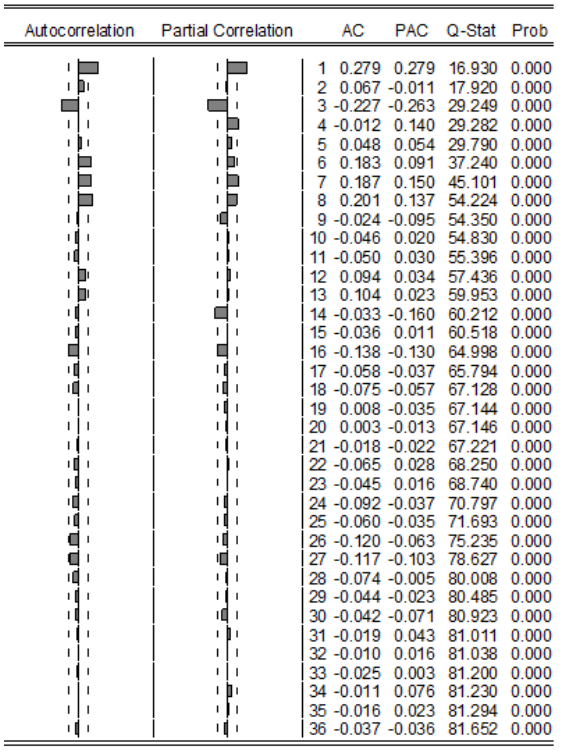


Figure 3: Differenced USD sell exchange rate
Source: Data library of the Central Bank of Sri Lanka (2020)



	AC	PAC	Q-Stat	Prob
1	0.279	0.279	16.930	0.000
2	0.067	-0.011	17.920	0.000
3	-0.227	-0.263	29.249	0.000
4	-0.012	0.140	29.282	0.000
5	0.048	0.054	29.790	0.000
6	0.183	0.091	37.240	0.000
7	0.187	0.150	45.101	0.000
8	0.201	0.137	54.224	0.000
9	-0.024	-0.095	54.350	0.000
10	-0.046	0.020	54.830	0.000
11	-0.050	0.030	55.396	0.000
12	0.094	0.034	57.436	0.000
13	0.104	0.023	59.953	0.000
14	-0.033	-0.160	60.212	0.000
15	-0.036	0.011	60.518	0.000
16	-0.138	-0.130	64.998	0.000
17	-0.058	-0.037	65.794	0.000
18	-0.075	-0.057	67.128	0.000
19	0.008	-0.035	67.144	0.000
20	0.003	-0.013	67.146	0.000
21	-0.018	-0.022	67.221	0.000
22	-0.065	0.028	68.250	0.000
23	-0.045	0.016	68.740	0.000
24	-0.092	-0.037	70.797	0.000
25	-0.060	-0.035	71.693	0.000
26	-0.120	-0.063	75.235	0.000
27	-0.117	-0.103	78.627	0.000
28	-0.074	-0.005	80.008	0.000
29	-0.044	-0.023	80.485	0.000
30	-0.042	-0.071	80.923	0.000
31	-0.019	0.043	81.011	0.000
32	-0.010	0.016	81.038	0.000
33	-0.025	0.003	81.200	0.000
34	-0.011	0.076	81.230	0.000
35	-0.016	0.023	81.294	0.000
36	-0.037	-0.036	81.652	0.000

Figure 4: Correlogram at first difference.
Source: Compiled by authors (2020)

Figure 3 illustrates the stationary time series, which revolves around the mean of zero. If a horizontal straight line is drawn from zero, it can be seen that the series exhibits mean reversion around zero (Ngozi, 2018). Therefore, the differenced sell exchange rate can be considered as stationary at first difference.

As indicated in Figure 1, the autocorrelation is gradually declining, and it is considered as a nonstationary set of time series. Earlier, by conducting the Augmented Dickey-Fuller method at its first differences, it was identified that the time series is converted to stationary. Therefore, the correlogram specification is conducted by running the first difference to make the time series stationary.

Table 3: List of developed models

	Significant coefficients	Sigma^2 (volatility)	Adj. R^2	AIC	SBIC
ARIMA (1,1,1)	1	0.434021	0.064664	2.040798	2.103507
ARIMA (1,1,3)	3	0.403219	0.131044	1.968229	2.030938
ARIMA (3,1,1)	3	0.406994	0.12291	1.977528	2.040237
ARIMA (1,1,7)	2	0.428	0.077639	2.027288	2.089997
ARIMA (7,1,1)	1	0.432982	0.066903	2.038717	2.101427
ARIMA (1,1,8)	3	0.412527	0.110986	1.992359	2.055069
ARIMA (8,1,1,)	1	0.422608	0.08926	2.015396	2.078106
ARIMA (1,1,16)	2	0.426026	0.081893	2.023465	2.086175
ARIMA (16,1,1)	1	0.430684	0.071857	2.034291	2.097
ARIMA (3,1,3)	1	0.440049	0.051673	2.055284	2.117993
ARIMA (3,1,7)	2	0.425745	0.0825	2.023704	2.086413
ARIMA (7,1,3)	2	0.432947	0.066979	2.039869	2.102578
ARIMA (3,1,8)	3	0.415564	0.10444	2.000955	2.063665
ARIMA (8,1,3)	2	0.43003	0.073266	2.033487	2.096196
ARIMA (3,1,16)	2	0.438435	0.055152	2.052497	2.115206
ARIMA (16,1,3)	2	0.444366	0.04237	2.065544	2.128253
ARIMA (7,1,7)	1	0.450932	0.02822	2.080258	2.142968
ARIMA (7,1,8)	2	0.43446	0.063719	2.044233	2.106942
ARIMA (8,1,7)	1	0.438243	0.055567	2.052299	2.115009
ARIMA (7,1,16)	1	0.445159	0.040662	2.06816	2.130869
ARIMA (16,1,7)	1	0.4435	0.044237	2.064636	2.127345
ARIMA (8,1,8)	1	0.440423	0.050869	2.058062	2.120772
ARIMA (8,1,16)	1	0.436289	0.059777	2.049323	2.112033
ARIMA (16,1,8)	1	0.436341	0.059664	2.049442	2.112152
ARIMA (16,1,16)	1	0.460914	0.006708	2.102	2.16471
ARIMA (4,1,1)	1	0.438477	0.055062	2.050949	2.113658
ARIMA (4,1,3)	2	0.449048	0.032281	2.075228	2.137938
ARIMA (4,1,6)	2	0.457058	0.015019	2.092799	2.155509
ARIMA (4,1,7)	1	0.450734	0.028647	2.079876	2.142585
ARIMA (4,1,8)	2	0.442646	0.046077	2.062987	2.125696
ARIMA (4,1,16)	1	0.460981	0.006565	2.102124	2.164833
ARIMA (1,1,6)	2	0.426452	0.080976	2.023564	2.086273
ARIMA (3,1,6)	2	0.43838	0.05527	2.051558	2.114268
ARIMA (7,1,6)	1	0.447508	0.0356	2.134825	2.097453
ARIMA (8,1,6)	1	0.437189	0.057837	2.04998	2.11269
ARIMA (14,1,6)	1	0.454689	0.020123	2.088056	2.150765
ARIMA (16,1,6)	1	0.449183	0.03199	2.076549	2.139258
ARIMA (14,1,1)	2	0.437953	0.056191	2.049897	2.112606
ARIMA (14,1,3)	2	0.451136	0.027781	2.079667	2.142376
ARIMA (14,1,7)	1	0.451286	0.027459	2.080924	2.143633
ARIMA (14,1,8)	2	0.440757	0.050148	2.059185	2.121894
ARIMA (14,1,16)	1	0.4605	0.007601	2.101141	2.163851

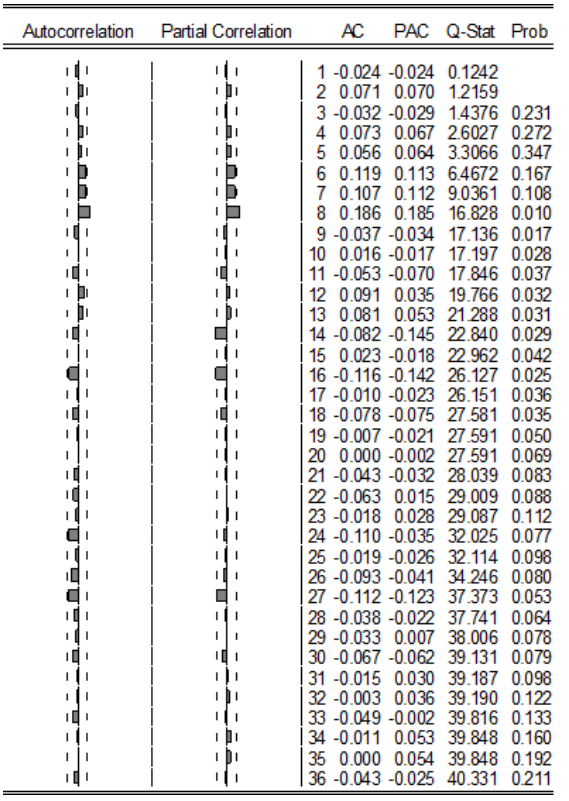
Figure 4 represents the correlogram of USD sell exchange rate at first difference. The data set has become stationary, and some of the lags have become significant since they have passed the standard error-bound line. These significant lags are used to create

the various models to estimate the most suitable ARIMA model to utilise in further analysis (Corrie, 2015). In Figure 4, both autocorrelation and partial autocorrelation are significant in lag 1, lag 3, lag 7, lag 8, and lag 16. Autocorrelation is significant in lag 6 and partial autocorrelation is significant in lag 4 and lag 14. A total of 42 models were created by combining the AR and MA values of significant lags.

Table 3 represents the list of models developed based on AR and MA values obtained from significant lags of the correlogram. The significant coefficients, volatility, adjusted r squared, Akaike Info Criterion (AIC), and Schwarz Criterion (SBIC) values were compared among the models to find the most suitable ARIMA model. From the list of models in Table 3, the model with the highest significant coefficient, lowest volatility value, highest adjusted r squared value, lowest AIC value, and the lowest SBIC value was selected as the best ARIMA model. Therefore, out of all the ARIMA models listed in Table 3, the ARIMA model (1,1,3) consists of the highest significant coefficient, lowest volatility value, highest adjusted r squared value lowest AIC value, and the lowest SBIC value. Therefore, the ARIMA model (1,1,3) was selected as the most suitable ARIMA model for the time series. In the ARIMA model (1,1,3), the first value "1" at the left-hand corner represents the AR, the middle value "1" shows that there is only one variable in the time series and the last value "3" at the right-hand corner represents the MA.

Figure 5 represents the correlogram of the estimated ARIMA model (1,1,3). The residual diagnostic test highlighted that the correlogram is not flat and lag 8, lag 14, and lag 16 are significant. Therefore, the focus was to capture as many lags as possible without overfitting the ARIMA model. Overfitting involves fitting a more elaborate model than the one estimated to see (Hipel & McLeod, 1994). There is still information that needs to be captured if there are significant lags after the residual diagnostic. Therefore, the previously estimated ARIMA model needs to be re-estimated. A new model was estimated using the significant AR and MA values generated in

Figure 5.



			AC	PAC	Q-Stat	Prob
1	-0.024	-0.024	0.1242		
2	0.071	0.070	1.2159		
3	-0.032	-0.029	1.4376	0.231	
4	0.073	0.067	2.6027	0.272	
5	0.056	0.064	3.3066	0.347	
6	0.119	0.113	6.4672	0.167	
7	0.107	0.112	9.0361	0.108	
8	0.186	0.185	16.828	0.010	
9	-0.037	-0.034	17.136	0.017	
10	0.016	-0.017	17.197	0.028	
11	-0.053	-0.070	17.846	0.037	
12	0.091	0.035	19.766	0.032	
13	0.081	0.053	21.288	0.031	
14	-0.082	-0.145	22.840	0.029	
15	0.023	-0.018	22.962	0.042	
16	-0.116	-0.142	26.127	0.025	
17	-0.010	-0.023	26.151	0.036	
18	-0.078	-0.075	27.581	0.035	
19	-0.007	-0.021	27.591	0.050	
20	0.000	-0.002	27.591	0.069	
21	-0.043	-0.032	28.039	0.083	
22	-0.063	0.015	29.009	0.088	
23	-0.018	0.028	29.087	0.112	
24	-0.110	-0.035	32.025	0.077	
25	-0.019	-0.026	32.114	0.098	
26	-0.093	-0.041	34.246	0.080	
27	-0.112	-0.123	37.373	0.053	
28	-0.038	-0.022	37.741	0.064	
29	-0.033	0.007	38.006	0.078	
30	-0.067	-0.062	39.131	0.079	
31	-0.015	0.030	39.187	0.098	
32	-0.003	0.036	39.190	0.122	
33	-0.049	-0.002	39.816	0.133	
34	-0.011	0.053	39.848	0.160	
35	0.000	0.054	39.848	0.192	
36	-0.043	-0.025	40.331	0.211	

Figure 5: Correlogram of the model (1,1,3)
Source: Compiled by authors (2020)

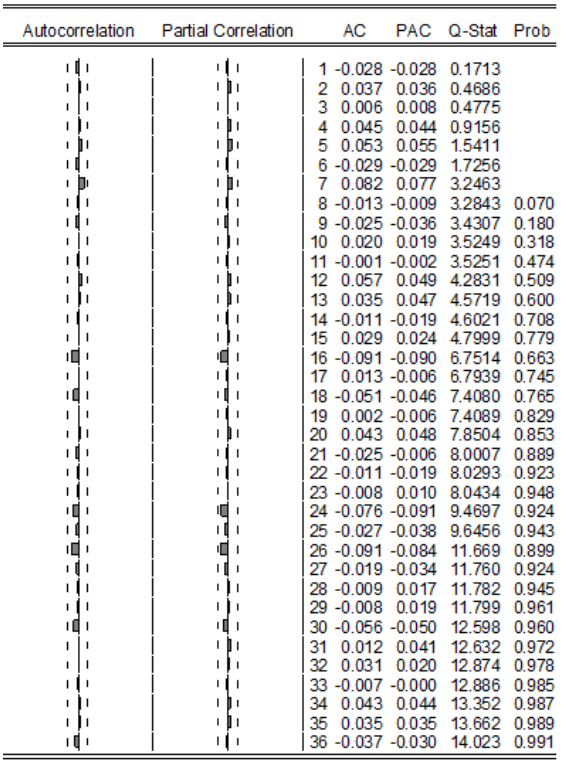
Table 4: List of re-estimated models
Source: Compiled by authors (2020)

	ARIMA (3,1,1)	**AR (1), MA (3), MA (8)**	**AR (1), AR 14), MA (3)**	**AR (1), AR (16), MA (3)**
Significant coefficients	3	3	3	3
Sigma^2 (volatility)	0.406994	0.388469	0.40032	0.397138
Adj. R^2	0.12291	0.158845	0.133184	0.140074
AIC	1.977528	1.941631	1.970777	1.963304
SBIC	2.040237	2.020018	2.049164	2.041691

Table 4 represents a new set of models estimated using AR and MA values obtained from the significant lags of the model (3,1,1). Among models in Table 4, the model with the highest significant coefficients, lowest volatility, highest adjusted R squared, lowest AIC, and the lowest SBIC is the model AR (1), MA (3), MA (8). The newly estimated model should go through the residual diagnostics process. Therefore, relevant correlogram tests were conducted, and the following results were obtained.

The correlogram of the estimated model AR (1), MA (3), MA (8) was irregular. However, some significant lags were identified from this correlogram. Therefore, it can be concluded that there was still more information to be captured by the correlogram. Autocorrelation and partial autocorrelation were significant in lag 6, and only partial autocorrelation was significant in lag 14 and lag 27. By combining the AR and MA values of significant lags, a total of 4 models were re-estimated as AR (1) AR (6) MA (3) MA (8), AR (1) MA (3), MA (6) MA (8), AR (1) AR (14) MA (3) MA (8), and AR (1) AR (27) MA (3) MA (8). From the models mentioned above, the model with the highest significant coefficients, lowest volatility, highest adjusted R squared, lowest AIC, and lowest SBIC was shown by the model AR (1) AR (6) MA (3) MA (8). Therefore, the chosen model was again checked using the residual diagnostics test. The correlogram obtained from the residual diagnostics test was irregular. Therefore, there was still left out information to be captured. Therefore, two models were re-estimated by combining the AR and MR values and utilising the significant lags in partial correlation (lag 14 and lag 27). Out of the two re-estimated AR (1) AR (6) AR (14) MA (3) MA (8) and AR (1) AR (6) AR (27) MA (3) MA (8) models, AR (1) AR (6) AR (14) MA (3) MA (8) model has the highest significant coefficients, lowest volatility, highest adjusted R squared, lowest AIC and the lowest SBIC values. The residual diagnostics test for the above-selected model resulted in an irregular correlogram. Only one significant lag was identified (lag 27) when examining the partial correlation. Therefore, AR (1) AR (6) AR (14) AR (27) MA (3) MA (8) model was created using lag 27 and was compared against AR (1) AR (6) AR (14) MA (3) MA (8) model. The highest coefficients, lowest volatility, highest adjusted r squared, lowest AIC, and lowest SIC values were generated from the model AR (1) AR (6) AR (14) AR (27) MA (3) MA (8). Therefore, a residual diagnostic test was conducted again with the model AR (1) AR (6) AR (14) AR (27) MA (3) MA (8). The residual diagnostics test failed to result in a flat correlogram because lag 27 in autocorrelation and partial correlation was significant. Therefore, re-estimation of the model was necessary. Out of the two re-estimated models, AR (1) AR (6) AR (14) AR (27) AR (11) MA (3) MA (8) and AR (1) AR (6) AR (14) AR (27) MA (3) MA (8) MA (11), AR (1) AR (6) AR (14) AR (27) MA (3) MA (8) MA (11) model show the highest coefficients, lowest volatility, highest adjusted r squared, lowest AIC, and lowest SIC values. After selecting the appropriate model, a residual diagnostics test was conducted to analyse whether the relevant model was suitable for performing the time series forecasting.

Figure 6 shows that after conducting the residual diagnostics test, the model AR (1), AR (6), AR (14), AR (27), MA (3), MA (8), MA (11) was received a flat correlogram. There are no significant lags present, and all the residuals are uncorrelated. Therefore, Figure 6 indicates that all the necessary information is obtained from the correlogram.



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.028	-0.028	0.1713	
		2	0.037	0.036	0.4686	
		3	0.006	0.008	0.4775	
		4	0.045	0.044	0.9156	
		5	0.053	0.055	1.5411	
		6	-0.029	-0.029	1.7256	
		7	0.082	0.077	3.2463	
		8	-0.013	-0.009	3.2843	0.070
		9	-0.025	-0.036	3.4307	0.180
		10	0.020	0.019	3.5249	0.318
		11	-0.001	-0.002	3.5251	0.474
		12	0.057	0.049	4.2831	0.509
		13	0.035	0.047	4.5719	0.600
		14	-0.011	-0.019	4.6021	0.708
		15	0.029	0.024	4.7999	0.779
		16	-0.091	-0.090	6.7514	0.663
		17	0.013	-0.006	6.7939	0.745
		18	-0.051	-0.046	7.4080	0.765
		19	0.002	-0.006	7.4089	0.829
		20	0.043	0.048	7.8504	0.853
		21	-0.025	-0.006	8.0007	0.889
		22	-0.011	-0.019	8.0293	0.923
		23	-0.008	0.010	8.0434	0.948
		24	-0.076	-0.091	9.4697	0.924
		25	-0.027	-0.038	9.6456	0.943
		26	-0.091	-0.084	11.669	0.899
		27	-0.019	-0.034	11.760	0.924
		28	-0.009	0.017	11.782	0.945
		29	-0.008	0.019	11.799	0.961
		30	-0.056	-0.050	12.598	0.960
		31	0.012	0.041	12.632	0.972
		32	0.031	0.020	12.874	0.978
		33	-0.007	-0.000	12.886	0.985
		34	0.043	0.044	13.352	0.987
		35	0.035	0.035	13.662	0.989
		36	-0.037	-0.030	14.023	0.991

Figure 6: Results of AR (1), AR (6), AR (14), AR (27), MA (3), MA (8), MA (11)
Source: Compiled by authors (2020)

The Ljung box test was conducted to identify whether the p-value of the model is more than 0.05. As shown

in Figure 6, each lag of the correlogram of the model AR (1), AR (6), AR (14), AR (27), MA (3), MA (8), MA (11) has a p-value more than 0.05. Therefore, it is concluded that the model AR (1), AR (6), AR (14), AR (27), MA (3), MA (8), MA (11) is the most suitable ARIMA model to forecast the relevant time series. The forecast was based on the adjusted ARIMA model for differenced sell exchange rates using EViews. The model AR (1), AR (6), AR (14), AR (27), MA (3), MA (8), MA (11) was utilised as the adjusted ARIMA model.

Table 5 represents the estimated output of the selected ARIMA model AR (1), AR (6), AR (14), AR (27), MA (3), MA (8), MA (11) using EViews. The model has three significant coefficients, volatility of 0.359219, adjusted r squared of 0.207077, AIC value of 1.905545, and SBIC value of 2.046642.

Table 5: Estimation output of the selected ARIMA model
Source: Compiled by authors (2020)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.029538	0.063264	0.466899	0.6411
AR(1)	0.291312	0.048705	5.981164	0.0000
AR(6)	0.167853	0.076111	2.205380	0.0285
AR(14)	-0.101732	0.142812	-0.712348	0.4771
AR(27)	-0.124385	0.108585	-1.145514	0.2533
MA(3)	-0.311496	0.046774	-6.659615	0.0000
MA(8)	0.260551	0.081907	3.181060	0.0017
MA(11)	-0.177043	0.119490	-1.481651	0.1400
SIGMASQ	0.351958	0.020129	17.48492	0.0000
R-squared	0.254528	Mean dependent var		0.026956
Adjusted R-squared	0.225436	S.D. dependent var		0.688726
S.E. of regression	0.606143	Akaike info criterion		1.889558
Sum squared resid	75.31900	Schwarz criterion		2.031118
Log likelihood	-193.1827	Hannan-Quinn criter.		1.946761
F-statistic	8.749178	Durbin-Watson stat		2.056090
Prob(F-statistic)	0.000000			

Figure 8 shows the forecasted and actual USD sell exchange rates during the prevailing COVID-19 pandemic situation. The forecasted values are denoted in red, and the actual values are depicted in blue. According to Figure 8, the USD sell exchange rate has moved in a range between Rs.180.00 to Rs. 184.00 during the last quarter of 2019. However, it has dramatically increased during the first three quarters of 2020 resulting Sri Lankan Rupee to fell to its lowest value of Rs.200.00 against the US dollar rates for the first time in history. This was the time that Sri Lanka faced COVOD -19 pandemic situation for the first time.

Table 6 represents the forecasted values, actual values, and forecasting errors. All the forecasted values have obtained a positive forecasting error. The Central Bank of Sri Lanka has not recorded actual USD sell exchange rates on 30th October 2020.

Table 6: Forecasted values vs actual values of USD sell exchange rates
Source: Compiled by authors (2020)

Date	Forecasted Sell Exchange Rate	Actual Sell Exchange Rates	Forecasting Error
19/10/2020	187.9	186.42	1.48
20/10/2020	188	186.48	1.52
21/10/2020	188	186.66	1.34
22/10/2020	188	186.44	1.56
23/10/2020	188	186.49	1.51
26/10/2020	188.1	186.4	1.7
27/10/2020	188.1	186.46	1.64
28/10/2020	188.1	186.46	1.64
29/10/2020	188.1	186.45	1.65
30/10/2020	188.2	-	-
02/11/2020	188.2	186.44	1.76
03/11/2020	188.2	186.61	1.59
04/11/2020	188.2	186.55	1.65
05/11/2020	188.3	186.57	1.73
06/11/2020	188.3	186.63	1.67
09/11/2020	188.3	186.64	1.66
10/11/2020	188.4	186.66	1.74
11/11/2020	188.4	186.65	1.75
12/11/2020	188.4	186.7	1.7
13/11/2020	188.4	186.7	1.7

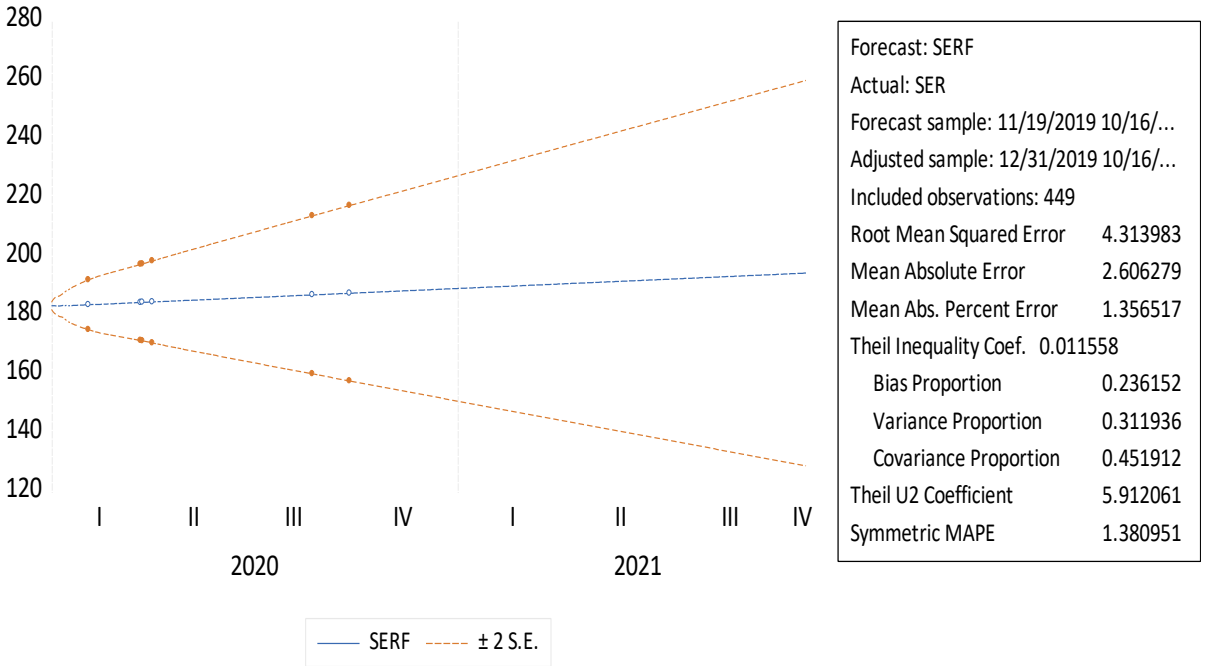


Figure 7: Forecasted values of sell exchange rate
Source: Compiled by authors (2020)

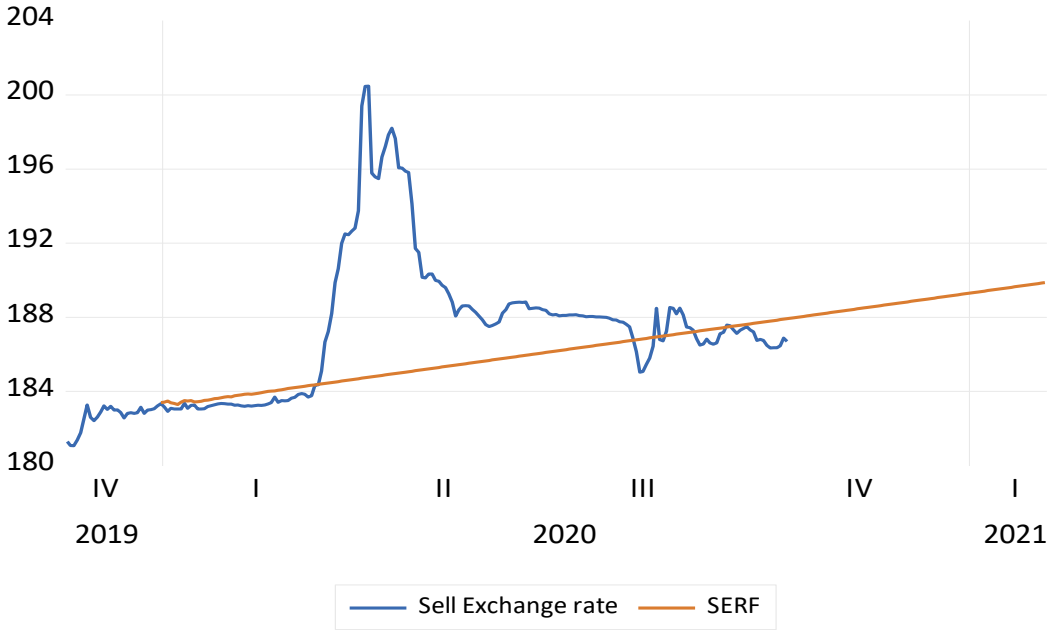


Figure 8: Actual vs the forecasted values
Source: Compiled by authors (2020)

Table 7: Forecasted USD sell exchange rates from 16.11.2020 to 31.01.2021

Date	Sell Exchange Rate	Date	Sell Exchange Rate	Date	Sell Exchange Rate
16/11/2020	188.5	14/12/2020	189	11/1/2021	189.5
17/11/2020	188.5	15/12/2020	189	12/1/2021	189.5
18/11/2020	188.5	16/12/2020	189	13/1/2021	189.5
19/11/2020	188.5	17/12/2020	189	14/1/2021	189.5
20/11/2020	188.6	18/12/2020	189.1	15/1/2021	189.6
23/11/2020	188.6	21/12/2020	189.1	18/1/2021	189.6
24/11/2020	188.6	22/12/2020	189.1	19/1/2021	189.6
25/11/2020	188.6	23/12/2020	189.1	20/1/2021	189.6
26/11/2020	188.7	24/12/2020	189.2	21/1/2021	189.7
27/11/2020	188.7	25/12/2020	189.2	22/1/2021	189.7
30/11/2020	188.7	28/12/2020	189.2	23/1/2021	189.7
01/12/2020	188.7	29/12/2020	189.2	25/1/2021	189.7
02/12/2020	188.8	30/12/2020	189.3	26/1/2021	189.7
03/12/2020	188.8	31/12/2020	189.3	27/1/2021	189.8
04/12/2020	188.8	01/1/2021	189.3	28/1/2021	189.8
07/12/2020	188.8	04/1/2021	189.3	29/1/2021	189.8
08/12/2020	188.9	05/1/2021	189.4	30/1/2021	189.8
09/12/2020	188.9	06/1/2021	189.4	31/1/2021	189.9
10/12/2020	188.9	07/1/2021	189.4		
11/12/2020	188.9	08/1/2021	189.4		

Table 7 represents the values that were forecasted until the end of January 2021. It was observed that the USD sell exchange rate will continue to rise at an alarming rate shortly. The USD sell exchange rate will increase up to 189.9 at the end of January 2021.

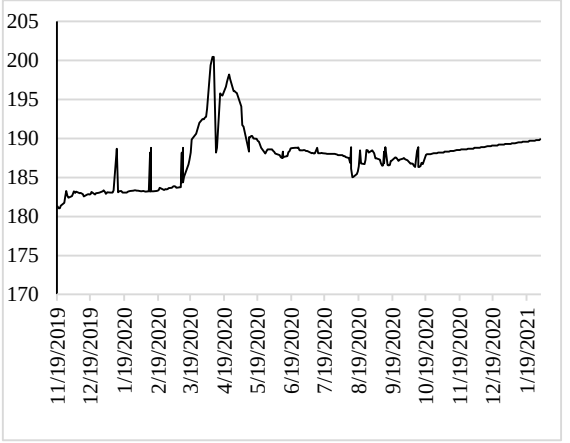


Figure 9: Actual values and forecasted values graphical illustration
Source: Compiled by authors (2020)

Figure 9 illustrates the actual USD sell exchange rate values until 18.10.2020 and the forecasted USD sell exchange rate values from 19.10.2020 onward. It can be observed that the forecasted values have a steady upwards moving line after 19.10.2020.

5. CONCLUSION

The study focused on the impact of the COVID-19 pandemic on USD sell exchange rates in Sri Lankan during the period of 19 November 2019 to 18 October 2020 and has forecasted until 31 January 2021. The Augmented Dickey-Fuller Test was utilised to check whether the series is stationary or not. The ARIMA model was utilised as the time series was stationary. Out of all the possible models, ARIMA AR (1) AR (6) AR (14) AR (27) MA (3) MA (8) MA (11) was identified as the most appropriate model to fit the time series. Further, the study has used the adjusted model for forecasting. It was determined that there is an increasing trend of USD sell exchange rate. Even though Sri Lanka is facing negative outcomes of the COVID-19 pandemic, necessary steps should take to minimise the speed of the reduction of rupee value against USD. According to the study, the exchange rate fluctuations are likely being soared up in 2021 if the COVID-19 pandemic situation continued and necessary precautions were not taken to control the devaluation of the Sri Lankan rupees. The study highlighted that if the pandemic continues in 2021, the Sri Lankan rupee will further depreciate against the USD resulting in Rs. 189.9 at the end of January 2021. Therefore, it is necessary to conduct further research to analyse how to avoid the devaluation of the Sri Lankan Rupee sell exchange rate against the USD during the pandemic or any other likely situations which would cause an impact on exchange rates.

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THE CURRENT ROLE OF COBALT-60 TELETHERAPY IN CANCER CARE

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ABSTRACT

Cobalt-60 teletherapy for cancer treatment is becoming less common. It is due to advances in Linac technology, such as beam collimation, conformal radiation therapy, and intensity modulation. Despite this, most developing countries rely on Cobalt teletherapy because of low prices, scarcity of skilled medical professionals, and uncomplicated treatment procedures. The goal of this study was to see how Cobalt teletherapy is used in cancer care around the world right now—the IAEA-DIRAC database to gather information for this investigation. Nearly every country has some radiation facility in the DIRAC areas. Other data gathered for all countries in DIRAC regions included the number of teletherapy machines and each country's population and income group. For every DIRAC region (high income, upper middle income, lower middle income, and low income), this chart information shows how many megavoltage treatment units are currently available. Within each income bracket, linear accelerators and Cobalt teletherapy machines were distributed in 2006, 2013, and 2020, respectively. Around the globe, there are currently 1766 Cobalt teletherapy units available, or 12.7% of all available external beam radiotherapy machines. The majority of Cobalt teletherapy units located in developing countries are about to 86 percent. Megavoltage machine per million people varies widely around the world. Currently, there is a 0.12 to 9.11 megavoltage machine per million population range available, which is supplemented by 0.04 to 1.41 from Cobalt teletherapy. Even though there is a declining trend, the use of Cobalt teletherapy is unavoidable in low- and middle-income countries to manage the increasing number of new cancer cases.

KEYWORDS: *Radiotherapy, Cobalt-60 teletherapy, IAEA-DIRAC database, DIRAC region, Megavoltage units per million population, Linear accelerators*

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1. INTRODUCTION

Cancer is one of the leading causes of death worldwide [Hyuna Sung et al. (2020), Freddie Bray et al. (2021)]. The Global Cancer Observatory (GLOBOCAN) 2020 predicts that in the year 2040, there will be 28.4 million new cases of cancer. Compared to the 19.3 million new cases reported in 2020 [GLOBOCAN (2020)], a 47 percent increase. Surgery, chemotherapy, radiotherapy, immunotherapy, hormone therapy, and gene therapy are just a few treatment options available for cancer. When used alone or in conjunction with chemotherapy and surgery, radiotherapy is critical in many cancer cases, whether the goal is curative or palliative. About half of cancer patients receive radiotherapy [Byron Burnette et al. (2013), Basker. R et al. (2017)]. Radiation entered the medical field as soon as Wilhelm Conard Rontgen in 1895 and Henri Becquerel in 1896 discovered X-rays and radioactivity. Much energy needs to be put into processes that damage DNA (Deoxyribonucleic Acid) in the body, such as ionization and excitation (such as X-rays, gamma rays, and carbon ions). Trial-and-error research produced brachytherapy and external beam radiotherapy, both developed due to collaboration between scientists and clinicians.

EBRT (external beam radiotherapy) and brachytherapy are the two main types of radiotherapy used in cancer treatment. In external beam radiotherapy, either a high-energy X-ray beam or light ion beam directs the patient from outside the body. In brachytherapy, the radioactive source is placed inside the tumor or near the tumor. There are only a few instances in which brachytherapy is utilized instead of external beam radiotherapy (EBRT). The external beam radiotherapy was started with kilovoltage therapy in the 1920s [Van Dyk. J et al. (2020)]. There was a limitation of less penetration and skin-sparing. Securing the radioactive source via sealed radioactive teletherapy is also an option for treating the problem. The Betatron (Megavoltage X-rays and electrons) and Microtron (Megavoltage X-rays and electrons) also were used in external beam radiotherapy.

External beam radiotherapy reached a milestone with the invention of Cobalt teletherapy in 1950 as it was able to provide increased photon penetration and skin-sparing. The first patient was treated with a Cobalt-60 machine in 1951 in Ontario, Canada [Van Dyk. J et al. (2020)]. The energy of Cobalt teletherapy is typically 1.25 MV, and the maximum dose (D_{max}) will be at 0.5 cm. Cobalt teletherapy treatment was better due to gamma rays' low megavoltage energy. It is ideal for treating head and neck cancers, breast cancers, and some types of superficial Sarcomas. But, for other cancer cases like the cervix, esophagus, lung, prostate, etc., the treating area's thickness would usually be greater than 20 cm. It will require complicated treatment plans to achieve the desirable isodose distribution.

During the remarkable growth of Cobalt teletherapy, the medical linear accelerator was introduced in 1952 [David. I and John. B (2006)]. There was a strong competition between Cobalt teletherapy and Linac. Linac is equipment that uses high frequency electromagnetic (EM) waves to accelerate electrons/charged particles to high energies. It can work in a dual-mode using high-energy electrons to treat superficial tumors. These high-energy electrons hit a target to produce high-energy photon beams. Medical Linacs replaced Cobalt teletherapy machines in many developed countries in the 1970s and 1980s due to rapid progress in Linac technology, such as multi-leaf collimators (MLCs), intensity modulation, and image guidance [Van Dyk. J et al. (2020)]. One major drawback in using radiotherapy is that healthy tissue can also be affected during the radiation treatment. Therefore, the foremost goal of radiation therapy is to precisely target the tumor volume with minimal exposure to the surrounding normal healthy tissue [Ramanathan V (2017)]. Newly introduced radiotherapy technology regularly helped patients to reach their treatment goals. Radiation therapy is advancing rapidly in terms of technology. Presently, particle therapy (proton, carbon ion, etc.) has been increasingly popular due to the steep dose fall-off (Bragg peak) depth dose profile [Ramanathan V and Peterson S (2019)].

Modern radiotherapy devices require very complex treatment techniques and exact applications. Therefore, a highly qualified multidisciplinary medical professional in the field of radiation oncology is required. Moreover, purchasing modern radiotherapy equipment, maintenance of radiotherapy equipment, and training health professionals are costly processes. Therefore, using modern radiotherapy equipment in cancer treatment is a challenging task for developing countries. Meantime, the new cancer cases are dramatically increasing. In this scenario, the Cobalt-60 teletherapy machine helps many low- and middle-income countries in cancer care.

The current view about Cobalt teletherapy is that it is an old treatment modality. It can be only applicable for palliative care or valuable for low- and middle-income countries with limited resources. Cobalt-60 teletherapy with multi-leaf collimators also was introduced to provide intensity-modulated radiotherapy. It was successful, but it was unable to compete with medical linac's versatile technology. The significant problems with Cobalt teletherapy are lack of sharpness of the beam edge due to the size of the Cobalt source and radiation penumbra, which hinder the confinement of the dose to tumor volume, and decaying radioactive Cobalt source, which leads to reduced output. The treatment time needs extended time as a result of the decreased output. In addition, the source should be replaced every 5 to 7 years because the half-life of Cobalt- 60 is 5.3 years, and the disposal of the decayed source is another major problem.

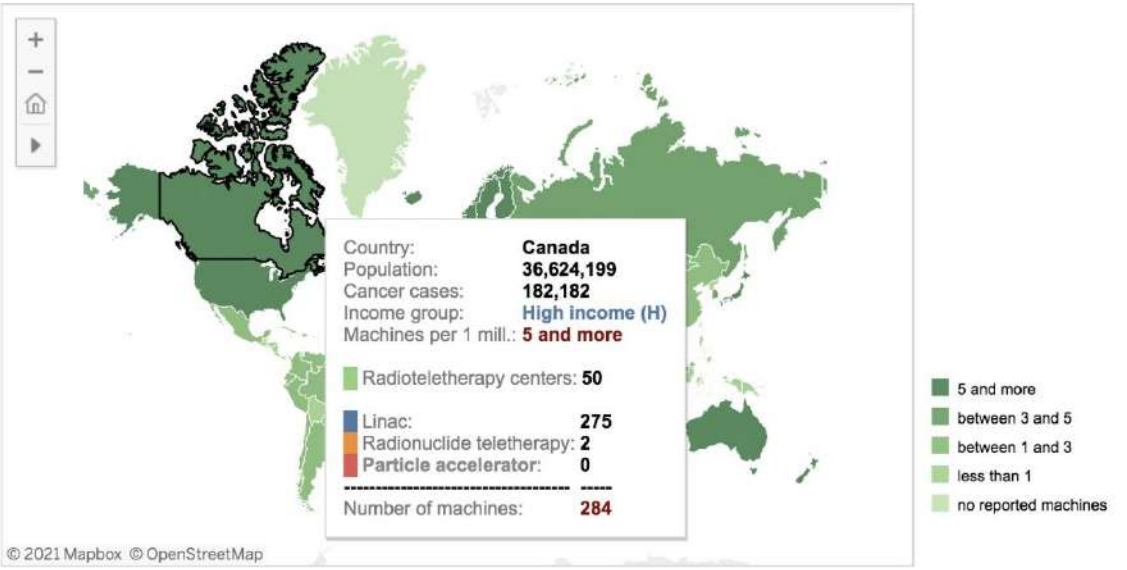
Moreover, the transport cost for Cobalt-60 radioactive sources and other radioactive sources used for medical and industrial purposes is expensive, and the transport process is also very complicated. Because of its simplicity, relatively low initial cost, lack of Quality Assurance (QA), and lower service charge than linear accelerators, Cobalt teletherapy machines still contribute to cancer care even though they have limitations. It is especially true in low- and middle-income countries. This study sought to determine how Cobalt teletherapy machines contribute to cancer care in the modernized radiotherapy era.

2. METHODS

Since its foundation, the International Atomic Agency (IAEA) has maintained an inventory of radiotherapy centers and radiotherapy equipment to help its member states. The DIRAC (Directory of Radiotherapy Centres) has established a database of more than 60 years of continuous work collaborating between IAEA and health professionals worldwide. At present, the DIRAC database comprises about 90% of globally available radiotherapy facilities. Mostly, all the updated data are according to the present status of facilities in each country [DIRAC (2021)]. In addition, the IAEA-DIRAC database offers the geographical distribution of radiotherapy facilities worldwide. The DIRAC database helps identify the gaps in the availability of radiotherapy equipment and calculate the needs of radiotherapy worldwide.

Globally available external beam radiotherapy facilities were identified using the IAEA-DIRAC database. North America, Mexico, Central America, Tropical South America, Temperate South America (including the Caribbean), Eastern Europe (including the Baltic States), and Northern Asia (including the Caucasus) consist of the most countries with radiotherapy facilities. Other regions with radiotherapy facilities include North Africa (including sub-Saharan Africa) and the Middle East (including the Arabian Peninsula). We counted the number of linear accelerators and light-ion therapy machines used in each DIRAC country. We also looked at the number of Cobalt teletherapy machines in use. According to the observations, all countries of the DIRAC region had varying income levels.

The information categorized into four groups helped analyze the differences between the various income levels: high-income countries, upper and lower-middle-income countries, and low and middle incomes. The mean megavoltage units per million people for each DIRAC region was calculated based on per capita income using the total number of external beam teletherapy machines (cobalt teletherapy and linear accelerator) and the



population.

Figure 1: Access to radiotherapy in Canada

It is vital to determine the number of Cobalt teletherapy machines per million people. The calculation proceeded by using the population and the available, total number of Cobalt teletherapy machines. Figure 1 shows the collection of data in Canada. The technique is similar for all other countries.

The observations indicated the distribution of linear accelerators and Cobalt teletherapy in high-income countries and low- and middle-income countries in 2006, 2013, and 2020 [DIRAC (2021), IAEA (2017)]. OriginPro data analysis program [OriginLab (2021)] helped the analysis of the future scope of Cobalt teletherapy in developed and developing countries.

3. RESULTS AND DISCUSSION

According to the DIRAC database, as of April 2021, only 145 countries out of 214 had radiotherapy facilities. There is no access to radiotherapy facilities in 51 countries, including 30 in Africa, that have no radiotherapy and depend on either non-radiotherapy treatment options or neighboring countries [IAEA (2017)].

Table 1 shows a summary of details on the availability of radiotherapy facilities in 145 countries. There is a total of 7610 radiotherapy centers worldwide. There are currently 13932 teletherapy units in use, with linear accelerators accounting for 86.6%. Cobalt teletherapy accounted for 12.7% of those, and light ion therapy accounted for the remaining 0.7%. Because light ion therapy necessitates a substantial financial commitment, it was limited to just 20 countries. The number of light ion therapy facilities in the United States (37) and Japan (23) is higher. India is the only country in South Asia that offers light ion therapy (also known as proton therapy).

Table 1: Globally available EBRT facilities

Detail	Total number
Radiotherapy treatment centers	7610
Teletherapy megavoltage units	13932
Linear accelerators	12063
Cobalt teletherapy machines	1766
Light ion therapy	103

Table 2 details the availability of external beam radiotherapy equipment (Cobalt teletherapy and linear accelerators) organized by the DIRAC region and income group. When analyzing the availability of radiotherapy facilities by a million population, we can understand the distribution of radiotherapy machines worldwide.

Table 2 [part A]: Availability of megavoltage teletherapy facilities. Notations indicate as follows: HIC – High-Income Countries, UMIC – Upper Middle-Income Countries, LMIC- Lower Middle-Income Countries, LIC – Lower-Income Countries, RT – Radiotherapy, and MV – Mega Voltage.

DIRAC region and Income group	Cobalt teletherapy	Linear accelerators	MV machines per million population (mean)	Contribution of Cobalt teletherapy to MV per million population (mean)
NORTH AMERICA				
Countries (2) and Countries with RT (2)				
HIC (2)	21	3715	9.11	0.05
MEXICO AND CENTRAL AMERICA				
Countries (8) and Countries with RT (7)				
HIC (1)	0	8	1.95	0
UMIC (4)	24	153	0.89	0.12
LMIC (3)	9	10	0.88	0.42
TROPICAL SOUTH AMERICA				
Countries (10) and Countries with RT (9)				
UMIC (8)	94	501	1.78	0.28
LMIC (1)	5	3	0.72	0.45
TEMPERATE SOUTH AMERICA				
Countries (3) and Countries with RT (3)				
HIC (2)	2	52	2.78	0.10
UMIC (1)	31	98	2.91	0.70
CARIBBEAN				
Countries (20) and Countries with RT (10)				
HIC (7)	3	32	5.39	0.46
UMIC (3)	14	28	1.69	0.56
WESTERN EUROPE				
Countries (26) and Countries with RT (19)				
HIC (19)	27	2750	7.04	0.07
EASTERN EUROPE AND NORTHERN ASIA				
Countries (29) and Countries with RT (28)				
HIC (10)	41	255	3.71	0.51
UMIC (12)	337	353	2.89	1.41
LMIC (5)	9	151	1.22	0.07
LIC (1)	6	1	0.22	0.19
NORTH AFRICA				
Countries (6) and Countries with RT (5)				
UMIC (1)	11	13	2.08	0.95
LMIC (4)	26	176	1.06	0.14

Table 2 [part B]: Availability of megavoltage teletherapy facilities. Notations indicate as follows: HIC – High-Income Countries, UMIC – Upper Middle-Income Countries, LMIC- Lower Middle-Income Countries, LIC – Lower-Income Countries, RT – Radiotherapy, and MV – Mega Voltage.

DIRAC region and Income group	Cobalt teletherapy	Linear accelerators	MV machines per million population (mean)	Contribution of Cobalt teletherapy to MV per million population (mean)
MIDDLE AFRICA				
Countries (45) and Countries with RT (21)				
HIC (2)	2	3	2.33	0.93
LMIC (6)	18	5	0.18	0.04
LIC (13)	16	27	0.16	0.06
SOUTHERN AFRICA				
Countries (6) and Countries with RT (4)				
UMIC (2)	1	8	0.61	0.07
LMIC (2)	3	101	1.13	0.03
MIDDLE EAST				
Countries (15) and Countries with RT (15)				
HIC (8)	12	414	1.68	0.05
UMIC (4)	8	88	1.54	0.13
LIC (3)	1	7	2.13	0.21
SOUTH ASIA				
Countries (8) and Countries with RT (5)				
LMIC (5)	396	377	0.44	0.23
EAST ASIA				
Countries (8) and Countries with RT (5)				
HIC (4)	580	2210	3.01	0.63
UMIC (1)	3	2	1.63	0.98
SOUTHEAST ASIA				
Countries (15) and Countries with RT (9)				
HIC (1)	0	2	4.67	0
UMIC (3)	6	77	0.80	0.06
LMIC (5)	59	198	0.56	0.13
SOUTHERN AND WESTERN PACIFIC				
Countries (13) and Countries with RT (3)				
HIC (2)	0	245	7.42	0
LMIC (1)	1	0	0.12	0.12

If the megavoltage machine per million population's access is very low, the patients have to wait long to receive radiotherapy treatment. It simply means that there is no access to radiotherapy. An internationally recognized radiotherapy facility is one megavoltage machine per 250,000 people [Surbhi Grover et al. (2015)].

Megavoltage machines per million people are most prevalent in North America (9.11), while low-income countries in the South and Western Pacific have the fewest (0.12). The analysis is due to the global distribution of megavoltage machines. The Cobalt teletherapy contribution is in the range of 0 to 1.41 megavoltage machines per population. East and northern Europe and Asia's upper-middle-income countries use Cobalt teletherapy the most (1.41 megavolt machines per million people). There is no Cobalt teletherapy usage in high-income countries of Mexico and Central America, Southeast Asia, and the Southern and Western Pacific. Generally, the usage of Cobalt teletherapy in high-income countries is less than that of low- and middle-income countries.

There are considerable disparities in radiotherapy access worldwide. Overall, there are significant shortfalls in radiotherapy facilities except in some high-income countries. Due to a dramatic lack of economic and human resources, most low- and middle-income countries are either unable to develop new radiotherapy facilities or expand their radiotherapy facilities to IAEA recommended levels of radiotherapy facilities. For example, in Nigeria, only one Cobalt teletherapy unit is available for about 100 million people. Using that Cobalt teletherapy machine for more than five years without replacing the Cobalt source will lead to a longer treatment time. Longer treatment time is uncomfortable for the patients. Also, increased treatment time leads to inaccuracy in treatment as the patients cannot be laid down on the treatment couch for a long time.

Figure 2 shows the distribution of Cobalt teletherapy units per income group of the world. The wealthy countries own more than two-thirds of the world's cobalt teletherapy devices, with the poorer countries owning the remaining one-third. The world's cobalt teletherapy machines are in countries with low income in 0.86% of cases.

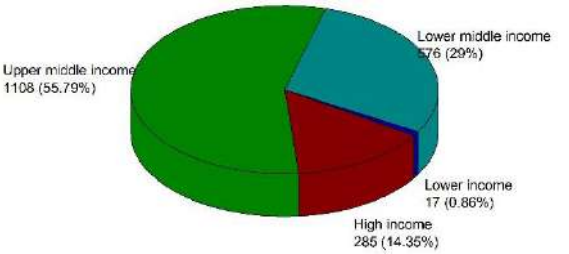


Figure 2: Distribution of Cobalt teletherapy units per income group of the world.

Figure 3 shows the disparities in the profile of existing linear accelerators and Cobalt teletherapy machines in developed and developing countries in the last two decades. In 2006, usage of Linacs was 85.3% in developed countries while only 37.3% Linac usage in developing countries. In 2013, Linacs usage in developed countries was 95.5%, whereas that of developing countries was 58%. In 2020, Linacs usage in developed countries was 96.8%, and in developing countries, it was 69.4%.

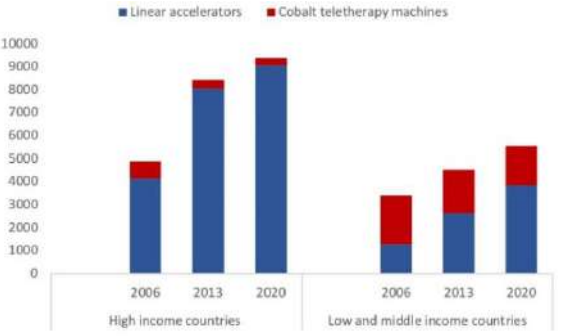


Figure 3: Distribution of linear accelerators and Cobalt teletherapy machines considering the level of income group.

Looking at the trend of Linacs in the last two decades, usage of Linacs gradually increased while usage of Cobalt teletherapy decreased both in developed and developing countries. Because of Linac's versatile technology, which provides conformal radiotherapy, increased accuracy, and low toxicity, most radiotherapy centres have switched from Cobalt teletherapy units [Van Dyk. J et al. (2020)]. At present, the installation and maintenance for low-energy Linacs are compatible with Cobalt teletherapy. Therefore, making installation of new Cobalt teletherapy is less likely in the future. But, some large radiotherapy centres in low- and middle-

income countries will invariably retain the Cobalt teletherapy machines for at least the next decade for palliative radiotherapy in the management of increasing cancer care.

4. CONCLUSION

The role of Cobalt teletherapy is considerable in low- and middle-income countries. Currently, available Cobalt teletherapy units are 1766, which is 12.7% of available teletherapy units globally. 86 percent of Cobalt teletherapy units are located in developing countries. There are significant disparities in megavoltage machines per million populations worldwide. From 0.12 to 9.11 megavolt machines per million people are available, with a Cobalt teletherapy contribution between 0 and 1.41. In teletherapy, developed countries currently have 96.7 percent of the Linacs used; however, developing countries currently have 69.5 percent of the Linacs used, down from 37.3% in 2006. Overall, the trend of using Cobalt teletherapy for curative treatment is gradually decreasing even in developing countries. For palliative treatment, large radiotherapy treatment centres may continue to use Cobalt teletherapy. A considerable number of radiotherapy treatment centres in low- and middle-income countries will have to use Cobalt teletherapy machines to manage dramatically increasing new cancer cases if they could expand their facilities in radiotherapy. The use of Cobalt teletherapy in the future is unavoidable in low- and middle-income countries.

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A REVISIT OF NATIONAL SCIENCE & TECHNOLOGY POLICY FOR THE DEVELOPMENT OF SMALL AND MEDIUM ENTERPRISES IN SRI LANKA

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ABSTRACT

Small and Medium Enterprises (SMEs) played a crucial part in the Sri Lankan economy and acknowledged as the country's backbone for industrial growth. However, the recent studies in this sector exhibit that Sri Lanka has not achieved the desired level needed in the modern world compared with other countries, especially within the region. This study examined and reviewed extensive literature, gathering information from experts in the national economic development and science and technology innovation. That helped to identify the major challenges on the National Science & Technology Policy (NSTP) and development of Sri Lankan SMEs, including various contributions to the national economy, with the challenges faced and the initiatives and incentives offered by related authorities. There are several significant factors identified among challenges. They are; lower level of science-based technological innovation, limited skilled of human resources with less commitment, the absence of broad-based scientific knowledge, weak implementation of policies, weak commercialisation of research & indigenous knowledge, poor sustainability of natural resources, lack of expert knowledge, high-cost technology import and leverage of much technology, informal use of technology, the reluctance of rural people to integrate with new technology and hesitance to pay for the technology, lower levels of research & development facilities, a high level of international competition, a high level of private-sector interference with less government involvement, and weakness of national fund gathering and distribution.These lapses suggest that the existing policies are insufficient or may not be delivered effectively to overcome these challenges. This study makes an effort to identify the irregularities of NSTP as a positive step and propose a way forward in formulating a workable framework to upgrade SMEs in Sri Lanka that would be highly effective.

KEYWORDS: *SMEs, National Science and Technology Policy, Sri Lankan economy, Industrial development in Sri Lanka, Science and Technology Innovation*

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1. INTRODUCTION

Small and Medium Enterprises (SMEs) play a significant role in economies, especially in developing countries (Pandya, 2012). They generate a vast amount of employment (Yogendrarajah *et al.*, 2017; Priyanath and Premaratne, 2014) while expanding the Gross Domestic Product (GDP) by stimulating different economic activities needed for the economic development of a country (Sakolnakorn, 2010; Chen and Rozelle, 1999). SMEs make up broad economic activities like agriculture, mining, production, construction, service sector industries, *etc.* (White Paper, 2002; Amaradiwakara and Gunatilake, 2016). Due to the scarcity of statistics in Sri Lanka, the total contribution of SMEs to the economic system is difficult to be assessed precisely. Recent publications represent that SMEs participate in the economy by fulfilling over 75% of the total enterprises and over 45% of total employment (Gunawardana, 2016) and making a 52% contribution to the GDP in Sri Lanka approximately (Gunawardana, 2020; Perera, 2018). There are almost 500,000 SMEs in Sri Lanka, with each employing three to five people on average (Perera, 2018). Furthermore, Sri Lanka has just over 3,000 SMEs (businesses with a turnover of but Rs.150 million) registered as exporters (Perera, 2018).

Since independence, having understood the reality, subsequent governments in Sri Lanka have taken varied steps to improve this important sector. Developing agro-based small and medium industries was one of the major concepts (Sinnathurai, 2013), and around 70% of the country's residents are in rural areas, where agriculture provides the livelihood of the majority of people (Wickremasinghe, 2011). Small industries such as the production of agro-based food products and agriculture are the sources of employment in rural areas. However, only a few studies have examined their current development and challenges and have proposed some prospects.

According to a few previous studies, the Sri Lankan export market still has low levels. For instance, Perera (2018) revealed that enterprises registered as exporters in Sri Lanka collectively contribute to less than 5% of Sri Lanka’s exports. In China, for example, SMEs contribute more than 40% of GDP, while the Asian average is around 30%. Weak business environment, inadequate infrastructure, inadequate access to finance, low technological capacities, lack of a mechanism for protection and nursing of SMEs, lack of drive for innovation, and lack of recognition have been identified as major drawbacks of SMEs (Perera, 2018; Nishantha, 2018; Perera, 2018). Moreover, Heenkenda *et al.* (2018) and Karunanithy *et al*. (2017) have reported various factors contributing to SME development under various perspectives in Sri Lanka. When reviewing these studies, it is clear that Sri Lanka has not gained the desired level needed in the modern world compared with other highly competitive developed and developing countries (China, Singapore, Thailand, Malaysia, and South Korea).

Considered East Asian countries are the latecomers to engage with industrialisation (Intarakumnerd and Goto, 2016). However, latecomer countries benefit from trailblazer countries' technological and institutional advancements (Gerschenkron, 1962). While competing in the global market, they faced several disadvantages. They lack R&D and engineering capabilities, poorly developed industrial and technological infrastructure operating in isolation from the world centres of science and innovation, dislocated from international markets, whose demands help stimulate technological advancements and innovation (Hobday, 1995; Morrison, 2019).

Numerous enterprises in East Asia were latecomer economies. China, South Korea, and Singapore could capitalize on their advantages and overcome disadvantages by improving their technological capabilities and building organisational structures.

This allowed them to enter and advance throughout the global value chain. This study intends to extract the core of policies to improve SMEs' technological and innovative capacities by examining the experiences of China, Singapore, Malaysia, Thailand, and South Korea. They were selected because their SMEs contribute significantly to the economies of these countries, and they are technologically successful. Their economy is dominated by enormous corporations as well as within these five economies, China,

Singapore, and South Korea are now high-income economies. At the same time, Malaysia and Thailand are still middle-income economies.

Furthermore, the present study aims to examine and analyse the current role of National Science and Technology Policy (NSTP) for SMEs' development and find a pathway to bridge the NSTP and SMEs' development by rectifying the issues about the NSTP. This study intends to identify and understand the need to start an SME by looking at all the factors affecting business success, reducing the risk of failure, and increasing the chances of success. That conforms to modern Science and Technology (S&T) main technical initiatives supplemented by reviewing innovation policies, research, and supportive reports in the above-selected countries to identify modern ideas that have influenced SMEs' business success. Finally, this study is aimed to propose amendments to the NSTP strengthening SMEs in Sri Lanka as a global competitor.

2. METHODOLOGY

This study was conducted mainly through a literature survey and via personal communication. The publications used regarding SMEs and S&T policies in Sri Lanka, China, Singapore, Malaysia, Thailand, and South Korea contained in databases such as Google Scholar, Science Direct, PubMed, Wiley Online Library, and Springer. Keywords used in this study were "Small and Medium Enterprises," "Small and Medium Industries," "Science and Technology Policy," "Science, Technology, and Innovation Policy," "Science and Technology Innovation," "Challenges and policy implications for SME development," "SMEs innovation," and "SME development" for all the selected countries respectively.

Besides, analysis of the current situations of the SMEs include secondary data from the latest industrial surveys of Sri Lanka. The Department of Census and Statistics conducted industrial surveys in 2013/14 (DCS, 2015) and Sri Lanka Labour Force Survey (Annual Report in 2019) (DCS, 2020). In addition to this, various other data sources such as annual reports of the Central bank of Sri Lanka, World Bank reports, OECD reports, other annual banking reports, and NASTEC reports (NASTEC, 2008; 2018; 2019) are also used.

In addition, the literature survey was conducted with the help of books, official websites on the internet, online published newspaper articles, and the reports & national policy frameworks were published by government sectors (i.e. NASTEC, MoDSIT, MoIC, MoSTR-2018). The National Science and Technology Commission, Sri Lanka, provided detailed information on the NSTP and its activities to Sri Lankan small and medium-sized enterprises (SMEs). Also, rural entrepreneur development programmes and their implementations were gathered from professionals at the Institute for Agrotechnology and Rural Development, University of Colombo, Sri Lanka (UCIARS).

The search was restricted to English language articles. All studies found during the search were independently evaluated for competence and inclusion. After compliance with inclusion criteria, experimental research and data resources that evaluate the effect of the NSTP component and SME development were included in the current study to propose strategies to improve the NSTP in Sri Lanka towards SMEs development and well distribution by the R&D sector to commercialise the outcomes through the SMEs.

NSTP in Sri Lanka

The history of S&T development in Sri Lanka has been a long one (NASTEC, 2008). As early as the 1950s and '60s, the Ceylon Association for the Advancement of Science lobbied activities on a major source of power. That resulted in assigning S&T to a Ministry. In 1994, this subject's greater opportunity helped establish a separate Ministry for Science and Technology. The National Science Council (NSC) initiated work on an NSTP, resulting in the first policy statement in 1978 (NASTEC, 2008). In 1991, a Presidential Task Force on Science and Technology Development drafted an expanded S&T Policy. The Science and Technology Development Act of 1994 led to the establishment of NASTEC (National Science and Technology Commission) in 1998, which serves as a policy advisory body for the government. NASTEC has continued the work to develop a complete and

comprehensive NSTP (NASTEC, 2008). The commission developed a complete and comprehensive NSTP, which the government approved in 2009 (Ratnasiri, 2016).

NSTP works on SMEs in Sri Lanka

The development of SMEs is a key concept to bring up the economy in many developing countries because it is the backbone of the social economy (Pratheeba, 2014). The role of SMEs in the Sri Lankan economy should not be underestimated, as they account for 45% of domestic employment and 52% of Sri Lanka's GDP (Perera, 2018; Gunawardana, 2020). As a result, SMEs operating in agribusiness (agriculture, forestry, and fishing), industry, and the service sector account for about 8.36%, 26.25%, and 59.67% of GDP contribution in 2020, respectively (Statista, 2021) (Table 1.). However, when analysing the sector's current contribution to the national economy, it has still not gained the desired level to compete with other countries (Figure 1). Quantity and the quality of the SMEs is a challenge due to low levels of modern S&T integration and entrepreneurs without broad scientific capabilities with an integrated approach to S&T. On the other hand, the lack of capital to pay for technology (a constraint for 59% of Sri Lankan SMEs), the lack of know-how on business plan preparation, and the excessive amount of regulatory impediments will keep entrepreneurs from accessing global demand (Ramanayake, 2019). Fortunately, however, it appears that Sri Lanka has a significant opportunity to develop this sector and reap the benefits that come with it. The Government has already identified this sector as a thrust area that should be developed to uplift the people's living standards (Gunawardana, 2016). Hence, the country's NSTP can provide a greater opportunity to make well developed & elaborated SMEs sector incorporating the government and private sectors collaborating with modern technology and financial efficacy. This is accomplished by offering guidance for resolving potential conflicts and maintaining a positive working relationship between these two.

However, promoting SMEs was not a major part of the current NSTP in Sri Lanka. Formulating policies, programmes, and projects, monitoring, and evaluating themes related to industry and commerce maintained under the purview of over 20 ministries have engaged with the business sector with over 90 departments/ authorities/councils established under such ministries. "Ministry of Industry and Commerce, Ministry of Primary Industries, Ministry of Development Strategies and International Trade, Ministry of Tourism Development, Ministry of Fisheries and Aquatic Resources Development, Ministry of Plantation Industries, Ministry of Agriculture are a few of them.

NSTP was originally developed by NASTEC, and implemented under the Ministry of Technology. Current NSTP leads to the development of S&T in the country and the application of S&T for national development. However, the NSTP must be included in the SME sector as the main stakeholder to execute the plan. For example, sunlight, the origin of all energies, was also taken for granted. If our S&T development had kept pace as in the past, we could be utilising sunlight, which we have in abundance, as our main source of energy instead of using petroleum, coal, *etc*. Billions of dollars used to import this fossil energy could have been saved and utilised for other necessities (Hirimburegama, 2020). Afterward, the R&D outcome got commercialised through SMEs in expecting a viable impact on the national economy. It will result in improved prospects for the young generation to develop technology-based enterprises and high-paying jobs.

Currently, NSTP focuses on S&T for social and economic development based on a few directions denoted as cultural innovation, national development, human resource, technology transfer & innovations, R&D, natural resources & the environment, indigenous knowledge, and intellectual property rights, quality improvement of S&T institutions, and human security (NASTEC, 2008). Under these directions, NSTP tries to provide equal and adequate opportunities for basic education related to S&T to foster novel technology and productivity to raise the efficiency of economic activities and promote S&T among the public, leading to a culture of innovation and entrepreneurship (STEPI, 2019). However, there is an urgent need to link NSTP directly with SMEs, an essential component of a progressive society in Sri Lanka.

Table 1. | Share of economic sectors in the gross domestic product (GDP) from 2015 to 2020 in Sri Lanka, China, Singapore, Thailand, and South Korea (Resource: Statista, 2021; Central Bank Annual Report, 2020).

Sector	Country	Share of economic sectors in the GDP					
		2015	2016	2017	2018	2019	2020
Agriculture	Sri Lanka	8.18%	7.43%	7.83%	8.02%	7.54%	8.36%
	China	8.40%	8.10%	7.50%	7%	7.10%	7.70%
	Singapore	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%
	Malaysia	8.29%	8.46%	8.60%	7.51%	7.26%	8.21%
	Thailand	8.87%	8.48%	8.41%	8.18%	8.14%	8.64%
	South Korea	2%	1.86%	1.85%	1.75%	1.62%	1.76%
Industry	Sri Lanka	26.20%	26.50%	26.80%	26.30%	26.40%	26.25%
	China	40.80%	39.60%	39.90%	39.70%	39%	37.80%
	Singapore	24.29%	23.30%	23.54%	25.50%	24.21%	24.37%
	Malaysia	38.45%	37.68%	38.11%	38.29%	37.40%	35.91%
	Thailand	36.18%	35.59%	35.02%	34.75%	33.60%	33.10%
	South Korea	34.15%	34.30%	34.77%	34.05%	32.83%	32.80%
Services	Sri Lanka	56.60%	56.70%	56.80%	57.50%	57.40%	59.67%
	China	50.80%	52.40%	52.70%	53.80%	53.90%	54.50%
	Singapore	69.95%	70.63%	70.33%	69.23%	70.67%	70.95%
	Malaysia	52.01%	52.53%	51.88%	52.99%	54.21%	54.78%
	Thailand	54.95%	55.94%	56.57%	57.07%	58.26%	58.25%
	South Korea	55.58%	55.36%	54.85%	55.69%	57.08%	57.02%

Note | These statistics show the share of economic sectors in the GDP in Sri Lanka, China, Singapore, Thailand, and South Korea from 2015 to 2020. In 2020, the share of agriculture in Sri Lanka's GDP was 8.36%, the industry contributed approximately 26.25%, and the services sector contributed about 59.67%. According to the data of the last six years, Thailand is the best country for the agricultural sector from among the selected countries. China is the best for the industrial sector contribution, and Singapore shows the best values for the services sector.

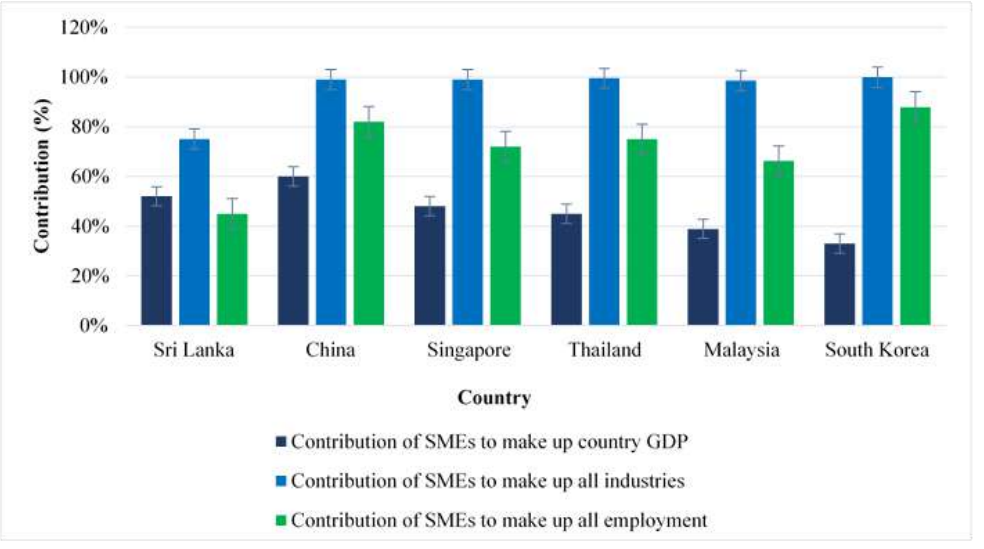

Figure 1. | Contribution of SMEs to make up the country economy, overall industries, and overall employment in Sri Lanka, China, Singapore, Thailand, and South Korea.

Lapses of NSTP in Sri Lanka

The absence of broad-based scientific knowledge with an integrated approach to S&T has usually limited the growth of an innovation culture. There is a major issue when dealing with society in working with scientific and technology-based work/projects. Therefore, the implementation of NSTP is very important to give basic S&T knowledge to young people, especially including school children who would become future entrepreneurs. But the practical mission requires a capital cost and expertise knowledge with proper planning.

Sri Lanka is endowed with a vast repository of indigenous knowledge that has been developed and practiced throughout two and a half millennia. Therefore, NSTP linking SMEs could be implemented by appropriating indigenous technologies for the local SMEs through research.

According to the highly labour-intensive manufacturing and limited capital investment, labour-intensive industries or processes require large quantities of physical effort to complete necessary tasks. In labour-intensive industries, the costs associated with securing necessary personnel are more important than the capital costs regarding importance and volume. In contrast, many labour-intensive jobs require low levels of skill or education, and this is not true of all labour-intensive positions (Kenton, 2019). When making a capital investment for SMEs, people have to use their cash reserves or seek a loan from a bank. Industrial economics and strategic management theory are now developing a new viewpoint on companies with limited technology adoption and innovation capacity. A high-tech approach is necessary for Sri Lanka to modernise its industrial systems. The capability exists, but they need to be looked after, giving high priority to such scientists. Since Sri Lanka shares many of the same concerns as NSTP, NSTP must investigate the country's case studies to make changes to the NSTP. Priority needs to health, education, and science and technology (S&T). NSTP is not in a position to control private-sector abuses (specifically, unnecessary establishments and mining, *etc*.), coordinate and regionalise services, regulate equipment and its use, and control charges, attempting to introduce prospective payment where possible. Furthermore, a great value addition would be, if the NSTP could focus on complications correlated with imposing import controls, and conservation of intellectual properties within Sri Lanka by providing short, medium, and long term solutions. Facilitating access to high throughput technologies for ongoing R&D projects, improving ongoing research through networking, and commercialising it through SMEs to obtain economic values, including patents, would be a solid initiative to protect intellectual properties within the mother country.

R&D can be the driving force of industrial innovations that accelerate economic development targets (Ratnasiri, 2007). NSTP may become a way of world-class facility provider for research in emerging S&Ts of national importance. Low R&D expenditures and low outputs, public R&D system misaligned with industry needs, low numbers of researchers and brain drain, low tech-transfer capacities are significant lapses of NSTP associated with R&D. Also, government universities and public research institutions pursuing to partner with industry or other organisations need a policy for effective intellectual property (IP) management and knowledge transfer. An IP policy provides structure, predictability, and a beneficial environment where enterprises and researchers can access and share knowledge, technology, and IP. A poor or insufficient IP policy for research commercialisation leads to a waste of intellectual property (WIPO, 2019). Therefore, NSTP has to add a new objective into its framework to develop a better IP policy linking public-private partnerships.

Laws pertaining on SMEs will also need to be updated to incorporate the possibility of arbitration in the event of a controversy. For this, identifying existing laws & regulations and identifying the gaps which need to be addressed relevant to the SME sector partnerships, designing, finalising & implementing the laws and regulations in line with the best international practices are highly required.

3. COMPREHENSIVE EVALUATION

The establishment of new science-based technologies helps protect the environment, build safer homes, schools, and factories with cost-effective energy resources and develop energy-saving transport systems. Advances in medicine resulted in better health for all residents (NASTEC, 2008). In this scenario, it is important to advance our knowledge in areas that are particularly important to us with a solid knowledge base with comparative competitive advantages. Then continuing progress in biotechnology, nanotechnology, and ICT promises further improvements in living standards and economic performance. Moreover, establishing world-class research centers to carry out cutting-edge research in areas important for national development is a key strategy in this scenario (Agarwala and Chaudhary, 2019; Kim, 2007). In addition to strengthening existing R&D institutions, such as ACCIMT, NERD centre, and biotechnology at universities and ITI, establishing world-class new research centres with advanced facilities in emerging technologies of national importance, such as nanotechnology, radioactivity use to improve the export market will be good targets for the country's R&D effort. NSTP may become a world-class facility provider for research in emerging S&Ts of national importance.

Even though the technology is available in the country, the lapses associated with SMEs in Sri Lanka are inappropriate planning, looking only for financial gains – attitudinal issues and high cost involved. Therefore, a proper mechanism needs to make the authorities to provide better direction to overcome lapses. Therefore, the amendments in NSTP for the inclusion and sustainability of SMEs are important.

Another is to address the maximum possible value addition to local natural resources and develop appropriate strategies for sustainable utilisation of the country's limited resources (Hirimburegama, 2020). A significant development in the country with the new government has to identify potential areas and appoint separate State Ministers to each area. HE, the President keeping the Technology Ministry, is a significant decision. Since independence in India, the Prime Minister served as the Minister of S&T, and a professional served as the Secretary.

NASTEC, the policy formulation commission is directly under HE the President is also an important decision.

With the approval of the Cabinet of Ministers, the State Ministry of Skills Development, Vocation Education, Research and Innovation formulated a National Policy (or current Ministry of Technology) on S&T in consultation with relevant stakeholders in Sri Lanka. The Policy reiterates the commitment of the Government, in partnership with the people, for the sustainable utilisation of the country's resources for the benefit of present and future generations. This Policy aims to ensure that the resources of the country are exploited to their optimal potential and subsequent appropriate value addition while ensuring sound environmental management within the sustainable development framework of Sri Lanka. This policy covers all SMEs' protocols within the jurisdiction of Sri Lanka. And is supported by other policies developed in relevant fields. Smooth implementation of this Policy will be ensured and managed by the line Ministry responsible for the subject of SMEs.

Sri Lanka is a country having rich biodiversity and natural resources, and also most of the SMEs are associated with rural areas. Hence, the availability of manpower is not a major issue, but lack of knowledge on S&T and proceeding industrial activities may become a severe challenge when entering the process. Thus, the NSTP might be revised to incorporate training for the workplace. Similar to the Singapore government, NSTP may include a bridge between universities and industries on technological collaboration, leading towards improved skills of graduates on persistence, networking, self-confidence, business planning, financial literacy, and managerial skills combined with positive attitudes & professional ethics (Lim, 2008). Thailand, Korea, China, and other Asian nations have already used this strategy (Park, 2019; Weerasinghe and Dedunu, 2020; Wong, 1999; Kim, 2007). Graduates from this programme would be well-prepared to assist the industry in developing new products and services, particularly small businesses

(OECD, 2018). The Government is also to give soft loans for beginners as done in South Korea.

For example, Sri Lankan universities have students with high education in every field. Enabling some of them to innovate technology and commercialise makes it possible to create many patent licenses for businesses. SME expansion is possible via adequate direction and strategy. At UCIARS, students can complete their degree programmes while developing small businesses in the fields they are interested in. With proper NSTP rules, Universities might be regarded as researchers and knowledge suppliers, leading to discoveries, innovations, and product commercialization. The developed nations have practiced it in that way. That converts the graduates as job creators rather than job seekers.

As part of the current NSTP, published in 2008, there are strategies for bridging universities and industries by developing and strengthening existing S&T institutions and universities to generate quality research and train scientists. That encourages industries, R&D institutions, and universities to emphasise innovations and technology transfer and commercialise research outcomes (NASTEC, 2008). These tactics currently exist at a very basic level. As an example, plant biotechnology research outputs are unlikely to get to the commercialisation stage by enhancing industrial reliability. They have only been able to publish the laboratory experience. Because of poor industrialisation and commercialisation, universities and research institutes have shied away from research-oriented university ideas. It only makes academically-oriented paths a reality. Comparatively, research may be expensive, but in the end, it yields little benefit or personal advantages that cannot significantly enhance the state of society).

The issue for Sri Lanka is its exceptionally low level of R&D investment since cross-national data plainly show that it falls behind even countries with lower per capita GDP. The Sri Lankan government had planned to expand R&D funding to 1.5% of GDP by 2016; however, this did not happen. Given such financial limits, it will be even more critical to identify key areas of S&T expenditure, which may need evaluating its financing objectives across multiple areas for strategic emphasis. In particular, S&T-driven transition into a knowledge economy necessitates a far larger emphasis on engineering and technology than has hitherto been provided (STEPI, 2019).

Why is R&D investment in Sri Lanka so low? There may be other things to consider, such as political, economic, social, or cultural causes. Is it attributable to government budget limits, a stagnating economy, or a more basic economic structure? What about ordinary citizens? Are they less scientifically literate or less supportive of science and technology? Such considerations should guide us in formulating preparations. Compared to South Korea, cross-cultural data from Hofstede shows that Sri Lanka has a low degree of uncertainty avoidance and a weak long-term orientation (STEPI, 2019). Some in rural areas who wish to become entrepreneurs have to obtain their skills through learning. Positive attitudes need to be inculcated rather than waiting until the state does everything. As in China, Thailand, Singapore, Malaysia, and South Korea, low-interest loans through NSTP would encourage youth to be involved in SMEs while learning the technology. Youth, especially in rural areas, need to get benefits from the partnership to develop SMEs.

As in Singapore, NSTP needs to develop towards attracting foreign talents. Additionally, attracting foreign direct investment to enable knowledge transfer from foreign to domestic firms will be part of the investment-driven and catching-up paradigm (Liu *et al*., 2017; Liu, 2008; Akhtar *et al*., 2016). To supplement the native technology available, the government should adopt a liberal immigration policy to draw in overseas skills. NSTP could also play a vital role by preparing linkages among authorities. Women in rural areas of Sri Lanka, if empowered, would educate their children and look for their prosperity.

Like the Spark programme in China, Sri Lanka also could create a programme directed by NSTP that could be packaged with S&T to benefit the rural poor. It should be an amendment with specific consideration of the needs of rural women. It could be the potential to improve the status of rural women by increasing their

incomes and participation in rural enterprises (Campbell, 2013; Fletcher, 1998; Vidanapathirana *et al.*, 2012).

In Sri Lanka, the Tourism Development Authority is the government agency in charge of tourism and related industry planning, development, regulation, and policy execution (SLTDA, 2020). Tourism is a very attractive industry in a country like Sri Lanka. Added values needed for the development of the tourism industry are herbal therapy, archaeological tourism, eco-tourism, *etc*., combined with modern technology (UNCTAD, 2021; Chung and yang, 2009; Prasanna *et al*., 2019; UNESCO, 2020, Vitarana, 2010). Then, NSTP will encourage the SME industry to make a business-friendly regulatory environment for local entrepreneurs with a conserving nature.

As in other countries, we should focus on main research areas such as finding new energy sources, i.e., solar, hydro, wind current, *etc*. Solar energy would have contributed to industry development if our S&T development had kept pace as in the past (Hirimburegama, 2020). Besides, renewable energy sources economically developed in the country include wind, biomass, and hydro. Aside from these, there are other sources such as wave energy, ocean thermal energy, geothermal energy, *etc*. So far, resource potential evaluations on wave energy have been carried out as part of initiatives including these sources (SSEA, 2021). However, it still has requirements for potential studies and pilot projects on other emerging technologies. According to a new analysis, the cost of renewable technologies such as wind and solar is dropping dramatically. That fuels the ascent of renewables as the world's cheapest energy source. The cost of large-scale solar installations get reduced by up to 85% in a decade. Removing pricey coal plants would also save approximately several gigatonnes of CO_2 every year. According to a new estimate, renewables will drastically undercut fossil fuels as the world's cheapest source of energy (Masterson, 2021).

NSTP could lead to a better legal environment and IP protection to industries and provide a better business-friendly regulatory environment for local entrepreneurs in Sri Lanka. This will encourage the graduates to support industrial innovation and stimulate the secondment of undergraduate and graduate students to innovation-oriented companies, in particular SMEs (OECD, 2018), giving systematic support for public-private innovation partnerships (Kulasinghe *et al*., 2018). The Korean work-frame can be taken as an example where commercialisation activities would be the main outcome.

NSTP needs to take steps to stimulate the local pharmaceutical and medical equipment industries, including medicine, with efficient benefit-sharing processes to encourage local medicinal practicians, *etc*. Developing mechanisms such as updating databases to retrieve, collate, and document indigenous knowledge and practices is important. Also, a well-developed traditional medicine system will be a good opportunity to improve tourist attraction towards the country. Sometimes, it will bring the best investments to the country.

Contemporary policies in S&T in Sri Lanka should focus on how SMEs are affected by the current COVID-19 pandemic. In the face of this uncertainty, many SMEs are already struggling with their financial instability. Financial aid should be made available to companies in Singapore to sustain their businesses and support employees affected by the ongoing pandemic. The sector-specific Industry Digital Plans can provide SMEs with a step-by-step guide on digital solutions to adopt and relevant training for their employees at different stages of their growth. Furthermore, during this situation, the government is responsible for coordinating between the private sector and the government sector. Introducing e-procurement programmes could be encouraged to further level the playing field for SMEs to compete for tenders with larger companies, direct investors, and domestic suppliers. Then policies and other government agencies need speedy modifications to prevent the breakdown of the supply chain and client relationships associated with small and medium industries. The Malaysian framework is a good example.

4. CONCLUSION

This study has examined and reviewed innovation policies, research & other supportive reports, and

personal communication regarding the development of Sri Lankan SMEs and NSTP, and their various contributions to the national economy. Also, the challenges faced and the initiatives and incentives offered by the government-related ministries and agencies. The review indicates that Sri Lankan SMEs account for over 75% of the total enterprises in the country, and it offers 45% of employment and contributes to 52% of the country's GDP. The evidence suggests that SMEs play a vital role in the development of the nation's economy. The key findings from this study are that NSTP in Sri Lanka should intervene to manipulate the domestic and global challenges faced by SMEs, which could hinder SMEs resilience and competitiveness such as:

1. Necessities such as power, water, and cutting-edge technology are too expensive for small businesses to purchase and might harm their survival ability. That is due to the lack of a one-stop shop from technology to commercialisation.
2. High-cost technology imports, maldistribution, and informal use of technology is a result of weak implementation of policies and the less-resourced economy of the country.
3. Most industries are associated with rural areas, and the village people supply the workforce. The rural communities need frequent on-the-job training. That avoids their reluctance to embrace new technology. Lack of knowledge and facilities to access modern technology, and ICT, hinders efficient and productive business operations among local SMEs.
4. Low R&D facilities with poor collaboration between universities, other research institutes, and SMEs lead to weak commercialisation of research & indigenous knowledge and poor sustainability of natural resources.
5. High level of international competition, high level of private-sector interference without government manipulation, and weakness of national fund gathering and distribution.

5. POLICY RECOMMENDATIONS

When considering the status of selected countries (China, Singapore, Malaysia, Thailand, and South Korea) for this study, Sri Lanka has a very weak status and is hard to compete with them. Therefore, developing and implementing an appropriate NSTP policy for upgrading SMEs in Sri Lanka is an urgent need. Having identified some of the challenges facing SMEs in Sri Lanka, some amendments/strategies are proposed to adopt the development of SMEs in Sri Lanka. The following amendments are to be included in the NSTP:

Entrepreneurs may get interest-free loans from the state banks for a period of one to two years to help them grow their small businesses. Interest rates may be set at 3 percent to 4 percent for another 1-2 years until the well-established sector. Those who plan to commence a business may need to follow a course to prepare a business plan, financial & legal aspects, S&T knowledge, supply chain with a positive attitude without waiting for the state to provide everything.

- That indicates the situation in all other countries.
- If indigenous knowledge/technology is available, start with it and gradually take up high technology for larger commercialisation.
- Improve the basic infrastructure (i.e. electricity, water) and be given at a low rate for three years until the business get established.
- Implementation of the National Science and Technology Policy (NSTP) under NASTEC to influence technical innovations within SMEs. Since promoting SMEs is not a mandate in the current NSTP, it is an urgent necessity as the mandate of NASTEC is finally to benefit people in the socio-economy.
- The NSTP can narrate towards the induction of S&T capabilities by increasing the number of projects offering consultancy and expertise knowledge to SMEs, such as ICT, financial planning, marketing planning, access to local and export markets, *etc*.
- Furthermore, the amendment of NSTP is necessary to develop SMEs to collaborate with the government and industries, universities, and research institutes to develop the R&D sector towards SME development.
- NSTP should be amended to establish new science-based technologies to protect the

environment, build safer homes, schools, and factories, develop energy-saving transport systems, advance in medicine, save lives and improve health standards throughout the country.

- The amendments would link NSTP with SME establishment and sustainability.

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ASSESSING THE EFFECTIVENESS OF AN ONLINE TEACHING INTERVENTION IN REDUCING THE PUBLIC SPEAKING APPREHENSION (PSA) AMONG THE SECOND-YEAR LAW UNDERGRADUATES IN KOTELAWALA DEFENCE UNIVERSITY

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ABSTRACT

Public speaking skills are a mandatory requirement for law undergraduates to become competent future lawyers. Public Speaking Anxiety (PSA) is one of the crucial issues faced by law students. Therefore, the current study was designed as a pretest-posttest design to evaluate the effectiveness of an online teaching intervention in reducing the PSA among second-year law undergraduates at the General Sir John Kotelawala Defence University (KDU), Sri-Lanka. More than fifty-three individuals from two of the four groups prepared to undergo lectures were randomly chosen for the study. The online teaching intervention continued for 15 weeks via the zoom platform. It consisted of gradual exposure, Communication Orientation Modification (COM), skills training, humour, and simple breathing exercises. A self-administered questionnaire consisted of an assessment of socio-demographic data followed by the Personal Report of Public Speaking Anxiety (PRPSA) scale was used in the data collection. The data were analysed using descriptive and inferential analysis in Statistical Package for the Social Sciences (SPSS) 23.0. According to the normality tests, the distribution of the pre-test data was normal, but the post-test data was not normal. Hence, the researcher used both parametric and non-parametric tests. The mean (±SD) age of the participants was 22.15 (±4.857) years, and the majority of them were females (83.0 %: n=44). A Wilcoxon signed-rank test showed that the 15-week online teaching intervention on managing the PSA had resulted in a statistically significant reduction in the PRPSA score (Z =-5.761, p=0.000). Hence, the current study has revealed that the online teaching intervention conducted among the second-year Law undergraduates in managing the PSA has successfully reduced the PSA among the study participants. However, further experimental research is needed to assess associated factors related to PSA among Law undergraduates.

KEYWORDS: *Law undergraduates, Online teaching intervention, Public Speaking Apprehension (PSA), Personal Report of Public Speaking Anxiety (PRPSA) scale*

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1. INTRODUCTION

According to the World Health Organisation, "Mental Health" is defined as a state of well-being in which individuals with the capacity to understand their abilities, manage coping strategies when dealing with stressful conditions in everyday life can work efficiently and successfully, and contribute to his or her community (Otorkpa, 2019). Mental health has been frequently conceptualised as an entirely positive effect, remarked by feelings of happiness and a sense of awareness over the environment (Lamers et al., 2011). Therefore, mental health is an essential aspect of health, and the WHO asserts that "there is no health without mental health" (Otorkpa, 2019). The identified mental disorders are depression, anxiety, stress, schizophrenia, and substance-related disorders that involve a vast range of problems with numerous symptoms. Further, they generally specify some combination of conflicting emotions, behaviours, thoughts, and relationships with others (Galderisi et al., 2015). As mentioned in the recent reports of the WHO, about 450 million people globally suffer from mental disorders (Otorkpa, 2019).

According to Jurewicz (2015), young adulthood is one of the most vulnerable categories, where young people encounter many problems related to mental health. The mental health issues faced by young adults by the time they enter their university life can bring potential threats to the success of their academic life (McLafferty et al., 2017). Hence, university undergraduates are one of the particular risk groups due to volatile lifestyle deviations connected with new friendships and social norms (Sravani et al., 2018). Moreover, their perception and coping strategies are affected during the transition from secondary education to university education. In this transition period, they must adjust to new routines and active learning methods (Orgilés et al., 2021).

Public Speaking Anxiety (PSA), which is also known as Public Speaking Apprehension, is classified as one of the social anxiety disorders as per the Diagnostic and Statistical Manual of Mental Disorders 5th version (DSM -5) (APA, 2013). The PSA is also labelled as Glossophobia and classified as a state of being nervous or distress generated with the anticipation of something intimidating. Moreover, the PSA has been identified as a predominant social phobia amongst young adults today (Herath, 2019). Further, it has a prevalence in 15% to 30% of the general population (Pull, 2012). Despite being experts in terms of their knowledge, poor public speaking skills become a threat to the success of many professionals. Moreover, in general, society has a negative impression of the people with PSA due to their inability to generate a positive impression.

There are three major divisions of the symptoms resulting from PSA: physical, verbal, and non-verbal. A person suffering from PSA will experience physical symptoms such as neck rigidity, acute hearing, increased oxygen intake, raised heartbeat, spasm of upper back muscles, enhanced sweating, and dilated pupils. Further, they may undergo verbal and no-verbal symptoms such as tense and shaking voice, vocalised pauses, and disturbing body language, respectively (Furmark, 2002). The research studies have revealed that females tend to have higher levels of a social phobia than males (McLean et al., 2011). Moreover, apprehension in communication can result in a weak competency and reluctance in engaging with public speaking; primarily, three mechanisms utilised to treat the apprehension, such as enhancing the levels of competency and skill-building, systematic desensitisation, and cognitive restructuring (Colbeck, 2011). It identifies that the approaches mentioned above can reinforce the students' performance (Colbeck, 2011).

Systematic desensitisation indicates that when people get frequent exposure to what brings them fear, it gradually reduces their anxiety (Bodie, 2010). It identified that one of the common origins of anxiety among people in public speaking is the feeling of newness and uncertainty. Hence gaining more experience in public speaking can potentially reduce the sense of newness and uncertainty. Systematic desensitisation, which is associated with encouraging the person to get repetitively engaged in the activity or the exercise, will bring high anxiety levels. People may begin to feel a sense of comfort as a consequence, and this may reduce the feeling of newness. In addition, it will facilitate them to experience a feeling of relaxation and easiness (Colbeck, 2011). It provides a gradual and systematic exposure for the individuals to the stimuli which cause the stressful condition.

Cognitive restructuring involves a change in the perspective about how the individuals view things. The initial step of coping with the PSA is to cognitively process fears and anxieties to comprehend that most of the thoughts generated within the PSA are unreasonable (Allen et al., 1989). Cognitive restructuring is classified as one of the effective mechanisms in reducing the levels of apprehension in communication. It focuses on directing the individuals with high levels of PSA to the observation and guidance of an instructor. The role of the instructor is to carefully understand the weaknesses within the individuals and assist them in generating optimism and motivation (Arnold, 2018). Improving the skills of the undergraduates through the training programmes is one of the critical interventions employed at the university levels in improving public speaking skills. The guidance that they receive from the instructors can boost their level of confidence. This method is identified as a very effective mechanism in reducing the PSA through the results of an experimental study (Colbeck, 2011).

Communication-orientation modification therapy (COM therapy) is one of the efficient types of cognitive restructuring that enables people to consider the act of public speaking as a conversation rather than a public speaking performance (Motley, 1997). It is commonly identified as a very effective strategy in managing the PSA.

The skills training programmes have measurable success in reducing PSA (Allen et al., 1989). A previous study was conducted to test the effectiveness of a skills-based programme to reduce anxiety during public speaking (Pribyl et al., 2001). Twenty-five Japanese college sophomores got exposed to a systematic approach for developing a presentation that was theoretically linked to mechanisms to reduce communication apprehension. Students have been asked to conduct four presentations which both teacher and their peers graded. Results indicated that the experimental group reported a significant drop in public speaking anxiety than the control group (Pribyl et al., 2001). Further, it was noted that the relaxation therapies like simple breathing exercises (Ebrahimi et al., 2019) had been used extensively in managing the PSA. Moreover, humour usage has been identified as a viable strategy to relieve anxiety (Menéndez-Aller et al., 2020).

The PSA is classified as one of the prevalent issues by law undergraduates. One of the essential skills of a lawyer is good public speaking skills, and lawyers are supposed to maintain effective interactions with their clients. Further, they should be capable of delivering arguments convincingly and fruitfully before the court. Hence, improving the public speaking skills of law undergraduates is one of the most valuable investments for their future. This has to be done at the initial stages of their university education so that by the time they become graduates, they will be able to enter the world of professionalism with high confidence levels. When the undergraduates are given the rightful exposure to improve their public speaking skills, many positive changes will happen in their personalities. Hence, it is evident that eradicating the PSA among law undergraduates is of greater significance as it can potentially impend their confidence as future lawyers (Brown, 2015).

Though PSA is an emerging issue throughout the world, the number of studies conducted in the Sri Lankan context related to PSA is very low, especially related to law undergraduates. Further, no studies were found to assess the effectiveness of an online teaching intervention in reducing the PSA among the law undergraduates in the Sri Lankan setting. The university education in Sri Lanka has largely shifted to online education with the outbreak of the COVID-19 pandemic. Therefore, it has become a mandatory requirement in research to assess the effectiveness of online education. It is vital to investigate how far online education successfully achieves similar outcomes obtained via onsite education. Hence, this study aimed to assess the effectiveness of an online teaching intervention in reducing the PSA among the second-year law undergraduates who follow compulsory public speaking modules at the General Sir John Kotelawala Defence University, Sri Lanka.

2. METHODOLOGY

Study design, study population and sample size

The study was conducted as a quasi-experimental pre-test post-test design among second-year Law undergraduates who study a compulsory 'Public Speaking' module at the General Sir John Kotelawala Defence University, Sri-Lanka. Usually, the lectures of second-year Law undergraduates are delivered by dividing the students into four equal groups. The study sample of 53 individuals was selected by choosing two groups randomly out of those four groups. The online teaching intervention was carried out for 15 weeks via the zoom platform, and PSA was measured before and after the online teaching intervention.

Data collection

A self-administered questionnaire consisted of an assessment of socio-demographic data followed by the Personal Report of Public Speaking Anxiety (PRPSA) scale – version 1.0 was used for pre- and post-test data collection. At the end of the intervention, the post-test was done to assess the PSA levels of the students. PRPSA scale is a 34-item one developed by McCroskey, J. C. (McCroskey, 1970), an excellent measure of PSA. The original creators of the scale granted permission for the scale to be used. Cronbach's alpha of the PRPSA scale ranges from 0.84 to 0.94 (Mörtberg et al., 2018), proving that the scale is very reliable. Furthermore, the severity of the PSA is categorised in PRPSA under three levels (High = > 131, Low = < 98 and Moderate = 98-131) and the response to each item was scaled in a Likert scale (1- Strongly Disagree, 2-Disagree, 3- Neutral, 4-Agree, 5-Strongly Agree) (McCroskey, 1970). The questionnaire was piloted among ten second-year law undergraduates to evaluate cultural appropriateness and comprehension, and they were excluded from the study population.

Online teaching intervention

The principal investigator, an academic member who teaches compulsory 'Public Speaking' module for the students, carried out the online teaching intervention via the zoom platform. The intervention group was exposed to an online teaching intervention of consecutive 15 weeks. During this period, the students were given both theoretical and practical exposure in managing the PSA. Throughout the fifteen weeks, the students were given comprehensive knowledge based on the theoretical framework of PSA management through the compulsory module. The students were asked to keep their cameras on during all the sessions, exposing them to an audience watching them. The breakout room option was used for group activities. The online teaching intervention in the current study was developed based on the previous research studies conducted on PSA worldwide (Anderson et al., 2005; Ayres et al., 2000; Dwyer and Davidson, 2007; Neer and Kirchner, 1991; Pribyl et al., 2001; Xu, 2015). The views of the subject and mental health experts were obtained when forming the online teaching intervention.

During the first two weeks, the students were exposed to the techniques in gradual exposure therapy. Through the use of various systematic techniques, the students were gradually exposed to public speaking that would cause them distress. The goal of gradual exposure therapy was to create a safe, comfortable environment to reduce anxiety. Element of humour was also used to expose the students to the act of public speaking. The students were divided into small groups (4-5 members) via the breakout room option, and each group was asked to prepare a speech on a topic that contains the element of humour: ethical, moral, and legal, which does not specify any individual or organisation. In the end, a randomly selected presenter from each group delivered the speech on the given topic for two to three minutes within their small group, and the principal investigator was there as an observer. This technique was used to make the students comfortable at the thought of delivering a speech. In addition to the practical tasks, they were also taught the theoretical framework for managing their PSA.

Moreover, the techniques in the Communication Orientation Modification (COM) therapy were utilised in the teaching. COM therapy is one of the efficient types of cognitive restructuring that enables people to consider public speaking as a conversation rather than a performance. The students were taught to practice the habit of looking at public speaking as a conversation that leads to an increasing level of confidence. When

public speaking is imagined as a normal conversation, the students tend to reduce their apprehension as they feel that they have already gathered experiences and skills that they can utilise. Further, they have been asked to visualise their act of delivering the speech before they deliver it to lessen their fear. Moreover, cognitive restructuring was used in teaching to give the students the ability to view public speaking as less threatening. Cognitive restructuring is taught as a self-management skill for dealing with negative feelings through the articulation of specific thoughts that underlie the distressing feeling and the objective evaluation of evidence supporting those thoughts (Mueser et al., 2015). Furthermore, the students were taught the importance of simple breathing exercises to relieve anxiety before presentations.

During three to five weeks, the students were asked to deliver speeches on simple topics of their interest. They were given a period of four to five minutes per speech. Then, each student received feedback from the group and the principal investigator. During this stage, the students were asked to perform simple breathing exercises before they delivered the speech to reduce apprehension. At the end of each session, the students were assisted with positive feelings to realise their irrationality of PSA by discussing it.

From the sixth to the ninth week, the students were instructed to deliver speeches on a more specific topic, and the number of students in a group was also increased gradually by decreasing the number of groups. As they were from the Law stream, the students were asked to prepare for speeches on Law related topics. Further, the students were subjected to a series of lectures that guide them in selecting a topic, understanding the psychology and the audience's needs, and how to carry out a proper research on a topic they have selected. In addition, the students were taught how to write their script correctly, add citations in a speech, and select reliable sources for information. Afterwards, the students were asked to prepare a proper script of their speech and feedbacks were given, including suggestions for further improvements. The time duration given for their speeches was also gradually increased up to ten minutes.

During the period of 10 -12 weeks, the students were exposed to the delivery of speeches on advanced topics ranging from fifteen to twenty minutes. Furthermore, they were given the chance of delivering their speeches in front of all the students. Further, the students were also asked to share the recorded versions of their presentations and feedbacks were given individually before the presentation. As a result, during the last two weeks of the interventions, the students could deliver lengthy speeches on advanced topics coupled with techniques of professionalism. Moreover, they were trained to become competent in giving constructive feedback on the speeches delivered by their colleagues.

Data analysis

Descriptive and inferential data analysis were performed with Statistical Package for the Social Sciences (SPSS) 23.0 version. Frequencies and the percentages of the socio-demographic data were analysed in the descriptive data analysis. The normality of the data distribution was evaluated using the Shapiro Wilk test, histograms and Q-Q plot analysis. According to the normality test, the distribution of the pre-test data was normal, and that of the post-test data was not normal.

Hence, both parametric and non-parametric tests were used. T-tests and ANOVAs were employed to evaluate the significant differences in the pre-test data across different socio-demographic variations with the PRPSA score. Meanwhile, the Mann–Whitney U and Kruskal Wallis tests were performed in the post-test among various socio-demographic variations with the PRPSA score. A significance of <0.05 ($p= <0.05$) was considered as statistically significant. Wilcoxon signed-rank test was used to evaluate whether there was any statistically significant difference between the PRPSA scores in the pre and post-tests.

3. RESULTS

Socio-Demographic data

Table 1 -Socio demographic data

Demographic	Characte-ristics	No.	%
Gender	Male	9	17.0
	Female	44	83.0
The highest grade obtained for G.C.E A/L General English?	A	26	49.1
	B	11	20.8
	C	14	26.4
	S	2	3.8
Taken part in extra-curricular activities	No	16	30.2
	Yes	37	69.8
Drama	No	26	49.1
	Yes	27	50.9
Toastmaster	No	37	69.8
	Yes	16	30.2
Singing	No	51	96.2
	Yes	2	3.8
Announcing	No	48	90.6
	Yes	5	9.4
MUN	No	51	96.2
	Yes	2	3.8
Debating	No	37	69.8
	Yes	16	30.2
Presented an item before	No	7	13.2
	Yes	46	86.8
Followed any courses related to public speaking	No	43	81.1
	Yes	10	18.9

The mean (±SD) age of the participants was 22.15 (±4.857) years. The majority of them were females (83.0 %: n=44). Most of the study participants (86.8%: n=46) had the experience of presenting an item in front of an audience. Furthermore, it was revealed that the participants have engaged in extra-curricular activities concerning public speaking such as Toastmaster (30.2 % n=16), Debating (30.2%: n=16) and Model United Nations (MUN) (3.8%: n=02). Further, most of the participants (86.8%: n=46) have presented an item in front of an audience. However, most of the participants (81.1%: n= 43) have not followed any courses related to public speaking (Table 1).

Pre-assessment of PSA

The mean score of the PRPSA obtained by the pre-test was 102.70 (±18.321). There was a significant mean difference in the PRPSA scores between the two genders (p= 0.042), engagement in the extra-curricular activities like debating (p=0.001), MUN (p=0.004), following the courses related to public speaking (p=0.020) and previous exposure to presenting an item in front of an audience (p=0.036). This study found that the PRPSA score of the male participants had a statistically significantly lower score (91.44± 22.604) compared to that of the female participants (105.00± 15.186), t (51) = -2.087, p=0.042. In addition, the PRPSA score of the study participants who are engaged in MUN had a statistically significantly lower score (67.00±18.385) compared to that of the participants who were not engaged (104.10±17.011) t (51) = 0.542, p=0.004. Further, it was revealed that the PRPSA score of the study participants who have done debating had a statistically significantly lower score (90.63±18.998) compared to that of the participants who have not done debating (107.92±15.546), t (51) = 3.474, p=0.001. Furthermore, there was a statistically significantly lower PRPSA score among those who have presented an item in front of an audience (100.65 ±17.503) compared to that of those who have not (116.14 ± 19.196), t (51) = 2.156, p=0.036 and also, among those who have followed courses related to public speaking (90.70 ± 20.451) compared to those who have not (105.49 ±16.844), t (51) = 2.402, p=0.020.

Posttest assessment of PSA

A Wilcoxon signed-rank test showed that the 15 week online teaching intervention on managing the public speaking apprehension had resulted in a statistically significant change in reducing the public speaking apprehension (z = -5.761, p=0.000). The median PRPSA score was reduced from 101.00 to 74.00 after the 15 weeks of online teaching intervention, and the mean score of the PRPSA obtained in the post-test was 82.50 (±18.672). Further, it was noted that there was no statistically significant difference between the two genders (p = 0.138), those who have taken part in drama (p=0.408), toastmaster (p=0.876), singing (p=0.479), announcing (p=0.153), those who have followed

courses related to public speaking (p=0.175) in the post PRPSA score.

Table 2 Associated factors for pre-assessment of PSA

Characteristic	Component	Mean	SD	*p* value
Gender	Male	91.44	22.604	0.042
	Female	105.00	15.186	
Drama	No	102.92	18.910	0.931
	Yes	102.48	18.095	
Announcing	No	104.17	18.396	0.070
	Yes	88.60	10.644	
Highest grade obtained for A/L	A	100.81	19.413	0.560
	B	99.36	15.769	
	C	107.50	19.090	
	S	112.00	9.899	
Toastmaster	No	103.43	19.001	0.524
	Yes	99.11	14.962	
Singing	No	102.29	18.288	0.423
	Yes	113.00	22.627	
MUN	No	104.10	17.011	0.004
	Yes	67.00	18.385	
Debating	No	107.92	15.546	0.001
	Yes	90.63	18.998	
Presented an item before an audience?	No	116.14	19.196	0.036
	Yes	100.65	17.503	
Followed any courses on public speaking	No	105.49	16.844	0.020
	Yes	90.70	20.451	

Further, the post-assessment has revealed that the post PRPSA score of those who have not done debating was statistically significantly higher than that of those who have done debating (U = 162, p = 0.009). It was also revealed that the post PRPSA score of those who have not engaged in MUN was statistically and significantly higher than that of those who have done MUN (U = 3.00, p = 0.024). Moreover, it was also highlighted that the post PRPSA score of those who have not presented an item in front of an audience was statistically and significantly higher than that of those who have not (U = 81.50, p = 0.035). A Kruskal-Wallis H test showed no statistically significant difference in the post PRPSA score with the highest grades obtained for English at the GCE A/L examination (p= 0.830).

4. DISCUSSION

The PSA is classified as one of the prevalent issues found among law undergraduates. One of the essential skills of a lawyer is good public speaking skills, and lawyers are supposed to maintain effective interactions with their clients. Further, they should be capable of delivering arguments convincingly and fruitfully in the courts. Hence, improving the public speaking skills of law undergraduates is one of the most valuable investments for their future. It has to be done at the initial stages of their university education. By the time they become graduates, they will be able to enter the world of professionalism with high levels of confidence (Brown, 2015). Therefore, it is essential to provide the university undergraduates with the necessary training to overcome the PSA before exposing themselves to the world of professionalism (Raja, 2017).

Moreover, due to the prevailing high levels in the PSA among university undergraduates, it is essential to take constructive measures to reduce the PSA (Heeren et al., 2013). However, it was noted that there were no interventional research studies conducted in Sri Lanka in reducing the PSA among the Law undergraduates, especially via the online platform. Hence, this study aimed to assess the effectiveness of an online teaching intervention in reducing the PSA among law undergraduates following a compulsory course module on public speaking. The online teaching intervention consisted of techniques such as gradual exposure, Communication Orientation Modification (COM), skills training, humour and simple breathing exercises.

As per the results of the current study, it was revealed that the 15 week online teaching intervention on managing the PSA has resulted in a statistically significant change in reducing the public speaking apprehension. Another similar experimental study has been carried out in Uva Wellassa University Sri-Lanka based on a group of third-year undergraduates following a compulsory module on public speaking. The study results have claimed that the undergraduates who were reported to have levels of PSA (64%) in the initial stage have been able to reduce their PSA levels up to 5% at the end of the module. The mean values of the pre- and post-tests of the PRPSA in that particular study were 132.69 (±30.350) and 91.10 (±26.202),

respectively (Herath, 2019). However, in the current study, mean values of the PRPSA in the pre and post-test were 102.70 (±18.321) and 82.50 (±18.672), respectively. It indicates that both pre- and post-test results are comparatively lower in the present study. The previous study was conducted based on students from different faculties. However, this study explicitly targeted law undergraduates who are expected to have speaking skills as a part of their profession, and that can be identified as one of the possible reasons for the low PRPSA mean values. Further, the exposure of the study sample into the defence setting and leadership programmes can also be identified as possible causes for the low levels of PSA. In addition, the previous exposure of the study participants in presenting an item in front of an audience and their engagement in extra-curricular activities related to public speaking like Debating, Toastmaster and MUN must have influenced in resulting a low level of PSA.

Finding out the associated factors for the PSA was one of the specific objectives of the present study. As per the pre-assessment results, there was a significant mean difference in the PRPSA scores between the two genders; however, there was no significant difference between the two genders in the post-test. This study also found that the PRPSA score of the pre-test, the male participants had a statistically significantly lower score than the female participants. Cross-sectional research carried out amongst Brazilian students enrolled in higher education institutes found out that there had been no significant mean difference in PSA between the two genders (Marinho et al., 2019). Moreover, another study has revealed that there had been no significant mean difference in the PSA between the two genders (Johnson, 2012). The post-assessment data concluded that there had been no statistically significant difference between the two genders. It is possible to indicate that the reason for this change must be due to the effectiveness of the intervention. Both genders might have benefited equally from the intervention in reducing their PSA.

The results of both the pre- and post-tests have revealed that there had been a significant mean difference concerning the participants who have taken part in the extra-curricular activities like debating, MUN and those who had previous exposure to presenting an item in front of an audience. Further, a similar study has revealed that the previous exposure to extra-curricular activities impacted reducing the PSA (Johnson, 2012). In addition, a research study has revealed that the students who have done debating have proven to have better presentation skills in public speaking (Raja, 2017). Therefore, it is an indication that the prior experience of extra-curricular activities associated with public speaking can enhance the students' confidence levels, leading to low PSA levels.

Conclusion and Recommendation

The current study has revealed that the online teaching intervention conducted among the second-year Law undergraduates in managing the PSA has successfully reduced the PSA among the study participants. It has also been identified that prior experience in extra-curricular activities associated with public speaking can reduce the PSA. Further experimental research is needed to assess associated factors related to PSA among law undergraduates. Reducing the PSA among law undergraduates can serve as a valuable investment for a successful future. It would lead to a positive alteration in their self-confidence, making them highly competent professionals.

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THE DETERMINANTS OF MIGRATION OF SRI LANKAN YOUNG ENGINEERS TO AUSTRALIA – A CASE STUDY

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ABSTRACT

The migration of professionals or brain drain is a widely discussed issue in developing countries. Professionally qualified engineers in developing countries migrate to developed countries for different reasons. Currently, young engineers who graduated from state universities in Sri Lanka migrate to Australia at an increasing rate. This research aimed to identify the push & pull factors that cause Sri Lankan young engineers to migrate to Australia as a case study. Using Facebook, we gathered a representative sample of Sri Lankan young engineers living in Australia and administered a 5-point Likert-type online questionnaire. Sixty-three engineers anonymously responded to the survey. The Australian government's introduction of the Subclass 476 – Skilled Recognized Graduate Visa is a significant motivator for Sri Lankan young engineers to migrate to Australia. Results showed that political influence and corruption were major driving forces behind the young engineers' migration, as were lower salaries and unfavorable working conditions in Sri Lanka. In contrast, opportunities for career advancement and education and a desire to gain exposure to a new culture are strong reasons to move to Australia. The majority of migrated engineers prefer the life they live in Australia. Outcomes of this study will support stakeholders of the engineering profession in Sri Lanka to tackle the brain drain issue of engineers in Australia.

KEYWORDS: *Australia, Brain Drain, Migration, Sri Lanka, Young Engineers*

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1. INTRODUCTION

Engineers play a major role in the value creation and economic development of any country with their knowledge and expertise. Most of the products, from tiny pins to skyscrapers in the modern world, are intellectual works of engineers. Therefore, they are an essential group of human capital for a developing country like Sri Lanka. As a country that also entertains free education at the undergraduate level, the Sri Lankan government spends a huge amount of money to create knowledge workers, including engineers required for the country's benefit. According to statistics of the University Grants Commission (U.G.C.) of Sri Lanka, the expenditure only on academic services for engineering degree programs of state universities was approximately Rs. 2,956,692,000.00 for 2018 (*Sri Lanka University Statistics 2018*, 2018). When considering the other expenses on general administration, welfare, maintenance, and other services in a state university, this value is far higher than the above. State universities in Sri Lanka currently admit more than 1500 students for engineering degree programs to cater to competent engineering professionals in the Sri Lankan industrial sector (*Sri Lanka University Statistics 2018*, 2018).

At present, a considerable number of engineering graduates of state universities migrate to other countries for employment or higher study perspectives. A trend of migration of graduate engineers to Australia, just within their first two years after graduation, can be observed during recent years. In other words, the goal of this study was to discover what drove young Sri Lankan engineers to migrate to Australia and what kept them there, causing them to make a permanent move. An engineering brain drain is taking place, and this introductory study's findings focus on delving more profoundly into the migration issue.

2. LITERATURE REVIEW

Migration is a term that many scholars widely discuss with the globalization of the world. The term "migration" refers to a move that is either permanent or temporary (Lee, 1966). There are no restrictions on how far one can move or whether the act was voluntary or not, and there is no distinction between internal and external migration. The migration process may be short or lengthy and convenient or complex. An origin and a destination are the main start and endpoints involved with any migration associated with many intervening obstacles. With the globalization of the world, many people are migrating to other countries due to different reasons. Irrespective of the educational level, people who live in war-torn areas migrate to other countries seeking asylum as refugees. The rest of the migrants move to other countries as temporary workers (skilled, semi-skilled, unskilled), skilled settlers, students, and tourists (Hugo and Dissanayake, 2017).

The concept of migration also has several theories put forward by scholars in different areas of the world. Ernest Ravenstein is broadly considered an initial theorist related to the migration process. He determined that a "push-pull" process directed migration; that is, unfavorable conditions in one place (oppressive laws, heavy taxation, etc.) "push" people out, and favorable conditions in an outside place "pull" them out. According to Ravenstein's theory, people migrate because of better job opportunities elsewhere (Lee, 1966). "Brain Drain" is a new term coined to describe the mass migration of highly educated professionals and knowledge workers. "Brain drain" refers to the exodus of highly educated people and knowledge workers from their homelands to places with better job prospects, living conditions, and standards of living (Jauhar and Yusoff, 2011). Human capital is disappearing at an alarming rate across countries (skilled workers and tertiary graduates). Because of the globalization-induced brain drain, developing countries are now experiencing difficulties (Dodani and LaPorte, 2005). Many scholars at the international level have conducted various research studies related to the brain drain of knowledge workers from developing countries (Ferro, 2004; Dodani and LaPorte, 2005; Dahl and Sorenson, 2010; Jauhar and Yusoff, 2011). Dodani and LaPorte (2005) discussed the key factors that cause the migration of talented health professionals from developing countries to developed countries. As per Dodani and LaPorte (2005), significant reasons for such migrations were expectations of economic improvements and higher education opportunities.

Out of the primary category of knowledge workers, scholars pay much attention to the migration of engineers as it affects the home country in both positive

and negative ways (Gokbayarak, 2012). As per research conducted on the brain drain of Turkish engineers, it was identified as a "brain overflow" in Turkey. The main reason for such migrations to other countries from Turkey was the discrepancy between education and employment policies in engineering (Gokbayarak, 2012). Like other developing countries, Sri Lanka also experiences the migration of qualified young engineers to other countries (Balasooriya, 1975; Gunawardhana and Jayalath, 2017). In Sri Lanka, a scholarly debate began on this topic in 1975 (Balasooriya, 1975). As a result, it demonstrates that the exodus of engineers has not yet begun. According to Balasooriya (1975), the brain-drain of Sri Lankans to wealthy countries netted the country Rs 110 million in annual aid while costing the country an additional Rs 128 million in lost revenue. Those values were calculated around the year 1975, considering engineers and the migration statistics of all the Sri Lankan knowledge workers at that time. What will be the loss to the Sri Lankan economy if these values are calculated based on present migration statistics?

Balasooriya (1975) has listed push and pull factors for the migration of professionals from Sri Lanka to other developed countries, focusing on engineers who migrated around 1975. According to that study, pull factors were higher salaries, savings, and educational opportunities for their children abroad. In contrast, the push factors were difficult to deal with international society, low living standards, discriminatory practices in Sri Lankan society, and a spirit of adventure to explore the world.

The migration of Sri Lankan engineers to foreign countries is rising at an alarming rate. The information available in the Ministry of Foreign Employment in Sri Lanka up to 2015 supports the above claim (Gunawardhana and Jayalath, 2017). In 2015, nearly 2500 Sri Lankan engineers migrated to other countries for different reasons. However, that value is greater than the annual enrolment of engineering students in state universities in Sri Lanka (*Sri Lanka University Statistics 2018*, 2018).

A study done in 2017 on the brain drain of Sri Lankan engineers has identified factors such as income, higher education for career development, and use of full potential as the major causes for the migration. Factors such as political influence, corruption, or living conditions were not the major causes for their migratory decisions (Gunawardhana and Jayalath, 2017). Furthermore, they have investigated the factors contributing to non-migrant engineers in Sri Lanka deciding to stay here without migration to other countries. Non-migrant engineers decided to stay in Sri Lanka not because they were satisfied with the income or job role in the industry but because of their family commitments and other reasons such as patriotic considerations. Moreover, they have further proposed strategies to retain competent professional Sri Lankan engineers without letting them migrate.

Nowadays, there is a trend of young engineers migrating more to Australia than to other countries. Australia is a country that offers valuable opportunities for knowledge workers who migrate there legally. Currently, Australia has become one of the important destination countries for Sri Lankan professionals like engineers and doctors, with an estimated population of 106,280 Sri Lankan-born residents in 2013 (Hugo and Dissanayake, 2017). Most Australian employers from small to large scale are willing to recruit skillful and expert knowledge workers like engineers who migrate from other countries since the Australian labor market is scarce of such human capital (Khoo *et al.*, 2007).

Most of Sri Lanka's engineering degree programs are now accredited following the "Washington Accord" criteria, thanks to improvements in the country's engineering education sector. Washington Accord is an international accreditation agreement for undergraduate professional engineering academic degrees between the bodies responsible for accreditation in its signatory countries and regions. Therefore, degree holders of such accredited degree programs in Sri Lanka can work as professional engineers in countries like Australia (a signatory country for Washington Accord) without additional academic qualifications (*The Institution of Engineers Sri Lanka - Accreditation of Engineering Degrees*, 2013).

With the introduction of new visa categories for professionals and skilled workers in 1996 by the Australian government, many Sri Lankans and skilled

migrants from other countries temporarily got the opportunity to work in Australia (Khoo *et al.*, 2007). Subclass 476 – Skilled Recognized Graduate Visa is a visa category introduced by the Australian government to allow fresh engineering degree holders to live, work or study in Australia for 18 months. Degree holders must have completed an engineering degree from an accredited institution within the past two years and be under 31 years of age (*Subclass 476 Skilled—Recognised Graduate visa*, 2020). Most young engineers migrate to Australia using an accredited engineering degree from Sri Lankan universities and a subclass 476 visa.

Although few scholars conducted researches on the brain drain of Sri Lankan engineers, commonly to foreign countries, no evidence is found in the literature explicitly focusing on Australian migrated engineers from Sri Lanka. Furthermore, the authors of this research paper have personally experienced the willingness of engineering undergraduates of the universities in which they work to migrate to Australia just after graduation. A discussion was held on the long-term objectives of engineering students recently between academics and undergrads. As a result, this research will serve as a springboard for further investigations into the brain drain of Sri Lankan engineers to Australia.

3. METHODOLOGY

A 2019 online questionnaire collected data anonymously. There were two sections to this questionnaire, each with survey questions of the quantitative and qualitative variables. Gunawardhana and Jayalath (2017) created a questionnaire to gather responses with five-point Likert-type answers. According to expectations, a panel of young Sri Lankan engineers quizzed what motivates and deters their desire to immigrate to Australia. The collection of samples using a convenient sampling strategy was due to the lack of statistics on the annual migration of Sri Lankan young engineers to Australia. Convenient sampling is a specific non-probability sampling strategy that relies on data collection from population members who are conveniently available to participate in the study (Jager, Putnick, and Bornstein, 2017). Although results cannot be generalized to the whole population with the convenient sampling, it can reveal unknown facts to the society (Jager, Putnick, and Bornstein, 2017). So those engineering colleagues who had recently migrated to Australia were contacted through an online questionnaire via Facebook. Other young engineers who migrated to Australia with the support of their colleagues posted it in various Facebook groups. Responses for 5 Point Likert-type questions were analyzed graphically following the descriptive statistical approach.

4. RESULTS & DISCUSSION

Sixty-Three people completed the online questionnaire with two reminders.

Demographic information of respondents

Migrant engineers who responded (Respondents) to the questionnaire had the following demographic information. The majority of respondents have had their undergraduate education at the University of Moratuwa (i.e.:71.4%). 17.5% and 6.3% of respondents studied at the University of Ruhuna and Peradeniya, respectively.

The majority of the respondents (i.e., 31.7%) were Civil Engineering graduates. Other respondents belong to engineering disciplines of Electrical & Electronics – 25.4%, Chemical & Materials – 19.0%, Mechanical & Manufacturing – 12.7%, Computer & Software – 7.9% and any other – 3.2%. The majority of respondents are young engineering graduates. Eighty-nine percent of those polled had graduated in 2015 or had done so within the previous year. Only 11.1% of those polled had received their diplomas before 2015. Since most of the respondents were young engineers, their experience in Australia is limited to a few years.

The majority of them (85.7%) were in Australia for less than two years. Only 9.5% of respondents were in Australia for 2 - 4 years, while 4.8% were in Australia for more than five years. At the time of the data collection, 38.1% of the respondents have applied for permanent residency (P.R.) in Australia. 61.9% of the respondents have not yet applied for P.R. in Australia.

Push factors of migration

Push factors stand for the reasons that push the persons from the mother nation (Balasooriya, 1975). On a 5-

Point Likert scale, respondents provided their perceptions of major push factors for Sri Lankan engineers to migrate. Balasooriya was the first to notice these contributing factors (1975). The use of graphics in data interpretation facilitates comprehension. The statements that respondents made on the survey are represented visually in the graphs.

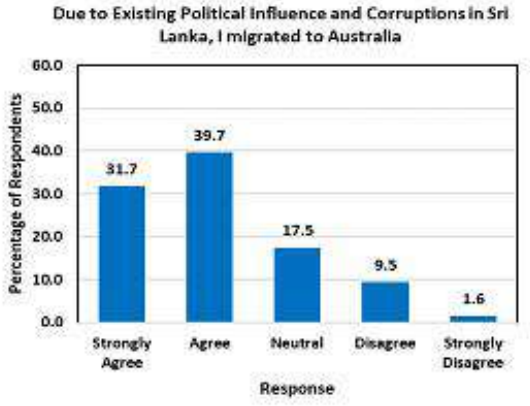

Figure 1: Perception of Existing Political Influence and Corrupt Practices in Sri Lanka

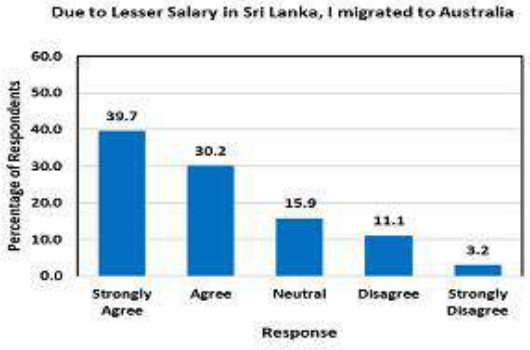

Figure 2: Perception of Lesser Salary in Sri Lanka

The majority of respondents (71.4%) have identified existing political influence and corrupt practices (Figure 1) in Sri Lanka as the major push factor for their migration to Australia. Only 11.1% of respondents disagreed or strongly disagreed with that, while 17.5% stayed in neutral perception. So, existing political influence and corrupt practices in Sri Lanka are in the first position among the push factors of migration. When reviewing the social media posts shared by the young generation of engineers in Sri Lanka, it is clear that most of them show critical disagreements on the prevailing political system in Sri Lanka. This result further confirms the findings of (Balasooriya 1975; Gunawardena and Nawaratne, 2017).

Figure 2 depicts respondents' agreement that engineering jobs in Sri Lanka pay less than other jobs in the country. 70.1% of respondents have agreed that lesser salaries in Sri Lanka have motivated them to migrate to Australia. Only 14.3% of respondents have shown their disagreement, while 15.9% have stayed in neutral perception. Therefore, the lesser salary in Sri Lanka is the 2nd major push factor of migration.

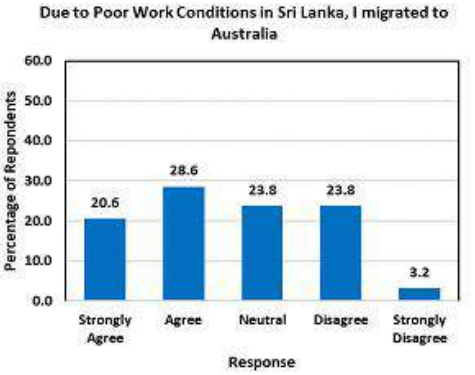

Figure 3: Perception of Poor Work Conditions in Sri Lanka

According to figure 3, 49.2% of respondents have agreed that poor work conditions in Sri Lanka were a push factor for their migration to Australia. Based on the percentage of agreement, poor work conditions in Sri Lanka become the 3rd major push factor of migration to Australia.

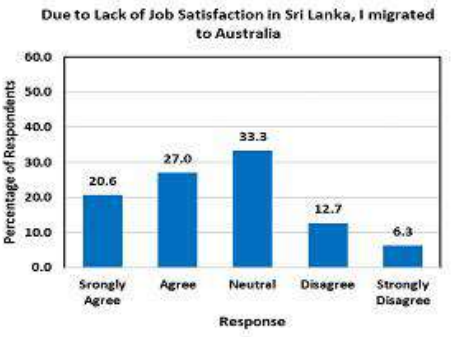

Figure 4: Perception of Lack of Job Satisfaction in Sri Lanka

Job satisfaction is one of the significant factors many professionals expect at the end of their day. If anyone has less satisfaction with their job, most of the time,

such people leave that job or perform with lesser efficiency. Figure 4 demonstrates the perception of respondents on their job satisfaction in Sri Lankan engineering jobs.

47.6% of respondents have identified that lack of job satisfaction has caused their migration to Australia. 19% of respondents have shown their disagreement on that push factor, and 33.3% have stayed neutral. So, lack of job satisfaction is the 4th major push factor as identified by the migrants.

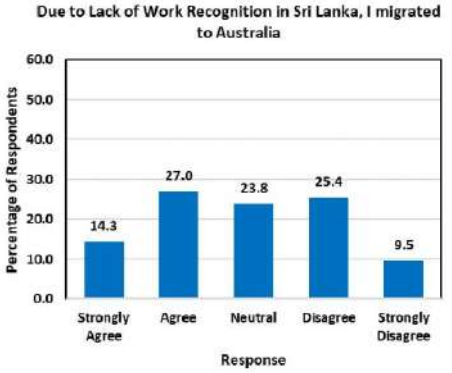

Figure 5: Perception of Lack of Work Recognition in Sri Lanka

In Sri Lanka, professional engineers have a considerable reputation. However, sometimes there is a lesser recognition from society for good work done by engineers. Only 41.3% of those polled said that a lack of work is a driving factor in engineers' decision to leave their current jobs. So, lack of work recognition is the least significant push factor that causes the migration of engineers in Sri Lanka.

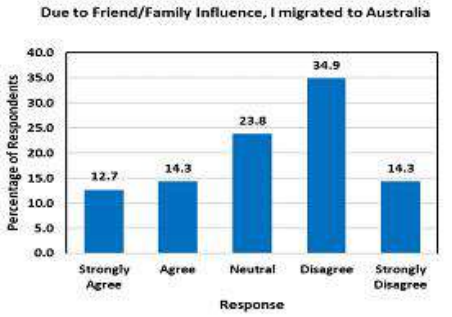

Figure 6: Perception of Friend/Family Influence on Migration

Figure 6 illustrates the impact of the push factor friend/family influence on migration. Only 27% of respondents have made their decision of migration considering that factor. Since 49.2% of respondents demonstrated their disagreement on this factor, it cannot be considered a significant push factor of migration.

Several major push factors should be addressed first from the individual level up to the policy level in Sri Lanka to minimize the migration of qualified engineers. In this case, Sri Lankan engineers also have a greater responsibility to direct the general public and other professionals to change the current corrupt practices in Sri Lanka.

Pull factors of migration

Pull factors stand for the reactions of the persons to excellent conditions of another country, which cause them to migrate (Balasooriya, 1975). Since the study's focus was on migration to Australia, the questionnaire included questions about the country's unique draw factors. 76.2% of respondents have migrated to Australia within the first two years after their graduation through subclass visa 376. Only 23.8% of respondents have utilized other forms of visas since they migrated to Australia after two years of graduation. Hence subclass visa 376 has motivated the majority of young engineers to migrate.

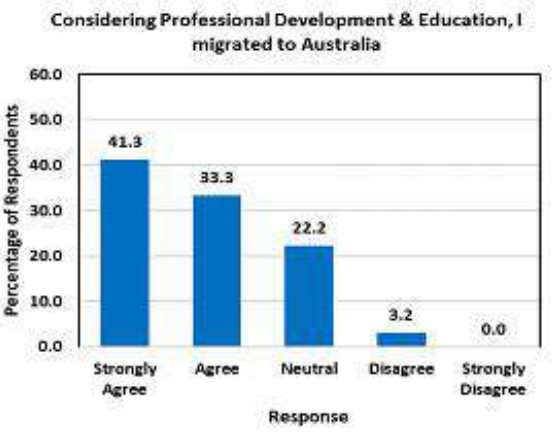

Figure 7: Perception of Professional Development & Education opportunities in Australia

According to figure 7, 74.6% of respondents have identified that Australia's professional development and education opportunities have motivated them to migrate from Sri Lanka. Only 3.2% of respondents have shown their disagreement on the above factor, while 22.2% were in neutral perception. In Australia, many

reputed universities offer world-class post-graduate degrees for engineers with scholarships. So, many young engineers who have engineering degrees with an excellent Overall Grade Point Average (G.P.A.) from Sri Lankan state universities tend to join Australian universities quickly.

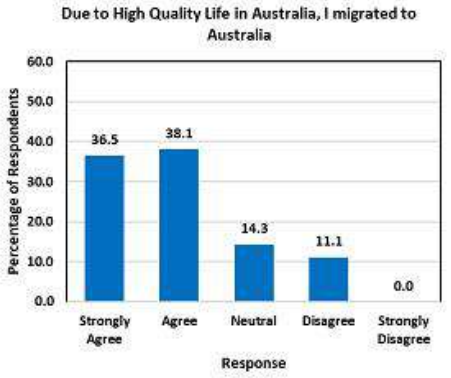

Figure 8: Perception of Quality of Life in Australia

Figure 8 illustrates the perception of Australia's high quality of life as a pull factor for migration. 74.6% of respondents have also agreed with that statement. Only 11.1% of respondents have shown their disagreement, while 14.3% have stayed in a neutral perception. When comparing the two pull factors illustrated in figures 7 and 8, both have similar agreement percentages. However, the factor of professional development opportunities in Australia has a higher response.

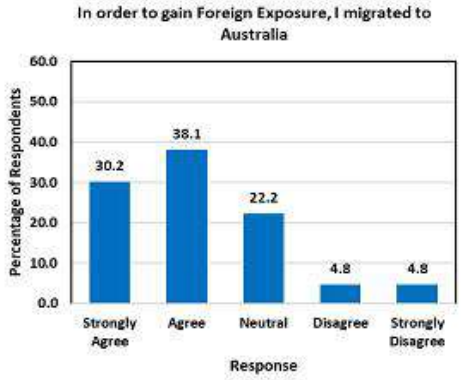

Figure 9: Perception of gaining Foreign Exposure

The percentage for the Strongly Agree option (41.3%) is higher than that of the Strongly Agree option for quality of life in Australia (36.5%). As a result, migration to Australia is driven primarily by professional development and education opportunities, with quality of life in Australia ranking as the country's second most crucial draw. According to Figure 9, most respondents (68.3%) have migrated to Australia to gain foreign exposure as professional engineers. Only a tiny percentage of respondents, like 9.6%, have demonstrated their disagreement for the above pull factor, while 22.2% were in neutral perception. As a result, the desire to broaden one's horizons by living abroad can be considered a significant pull factor for moving to Australia. 47.7% of respondents have migrated to Australia with an expectation to use their full potential as engineers. 33.3% of respondents were neutral on that, while 19.0% have shown their disagreement with that pull factor.

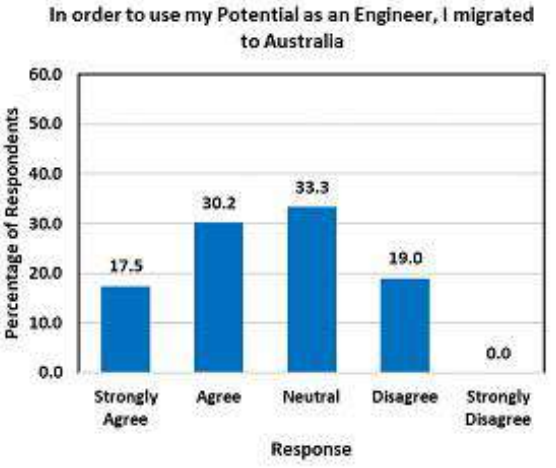

Figure 10: Perception of Available Opportunities in Australia to use the full potential as an Engineer

Informal discussions of authors with engineering colleagues in Sri Lanka have revealed that many engineering graduates are not involved in purely engineering or technical jobs. Most of their job roles comprise management and people-handling aspects. However, some engineers do not like that situation. They expect to use their full potential as engineers in R & D or technical fields (Fahim, 2012). Maybe due to that reason, the expectation of using the full potential as an engineer has become the 4th major pull factor for migration to Australia.

When considering the primary pull factors of migration as identified in this research, Sri Lanka needs to consider many aspects to retain qualified engineers. More professional development opportunities should be provided for graduate-level engineers while

enhancing the quality and recognition of post-graduate degrees in engineering offered by local state universities. Graduate engineers should be encouraged to pursue their post-graduate education in local universities while incorporating some form of international level exposure to them through such local post-graduate programs. However, all engineering stakeholders should work together to find a solution to the salary issue. Otherwise, the migration problem of qualified engineers from Sri Lanka will become a more severe problem for the country's economic development.

Migrant Engineers and Australian Life

This section discusses some important aspects of Australian life as experienced by respondents.

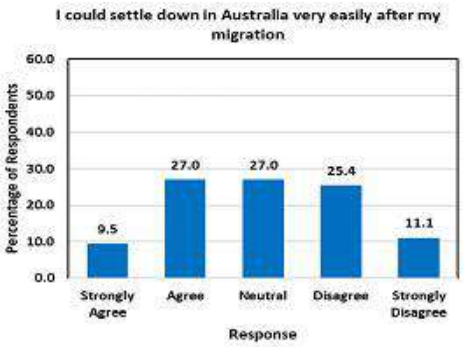

Figure 11: Perception of Convenience in Settling Down in Australia

Figure 11 demonstrates mixed results on perception. Two sets of 36.5% of respondents have shown their agreement and disagreement on the convenience of settling down in Australia after migration. As per the responses, for the engineers to settle down in Australia is not easy for every migrant engineer.

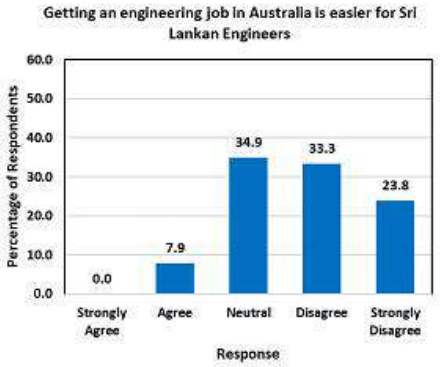

Figure 12: Perception of Convenience of Getting an Engineering Job in Australia

According to Figure 12, getting an engineering-related job in Australia is also tricky for Sri Lankan engineers. Even though most engineering degrees awarded by Sri Lankan state universities are internationally recognized, obtaining an engineering-related job in Australia necessitates obtaining permanent residency (P.R.) there. Getting PR in Australia is somewhat tricky, although graduate engineers migrated to Australia temporarily for 18 months under subclass visa 376 (*Subclass 476 Skilled—Recognised Graduate visa*, 2020). So, most migrant engineers have to do odd jobs not relevant to their educational qualifications until they get PR in Australia.

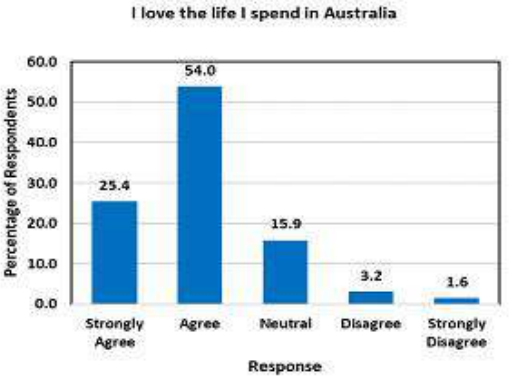

Figure 13: Perception of Life Experience in Australia

Figure 13 demonstrates respondents' perception of their life experience in Australia. The majority of respondents (79.4%) prefer the life they spend in Australia. Only 4.8% did not like Australian life, while 15.9% stayed neutral.

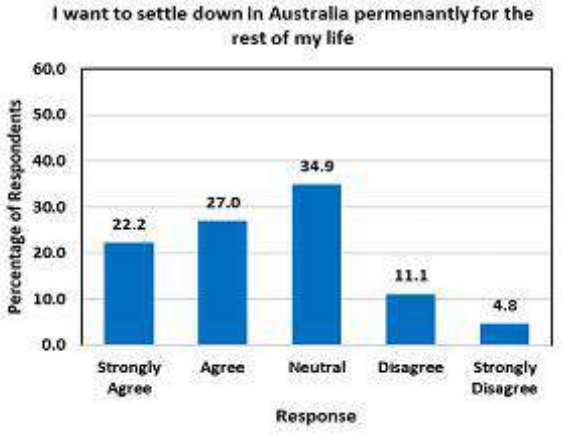

Figure 14: Perception of Intention to Settle Down in Australia

According to Figure 14, nearly half of the respondents (49.2%) need to settle permanently in Australia, while 15.9% do not need to settle down in Australia. Neutral respondents will also decide with the time to settle down there or come back to Sri Lanka. However, according to Figures 13 and 14, it is clear that only a few migrant engineers will return to Sri Lanka permanently from Australia.

There should be a way of getting the support of migrant engineers for the economic development process of Sri Lanka. To help the local engineering community develop, they should be willing to share the knowledge and experience they have gained while living in Australia.

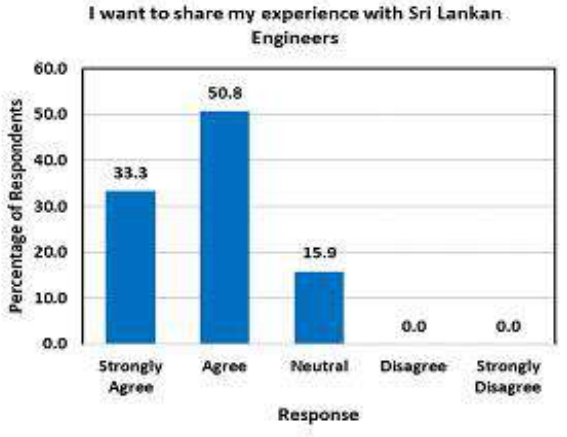

Figure 15: Perception of Sharing Experience

As per Figure 15, most respondents (84.1%) are willing to share their experience with Sri Lankan engineers in the future. Although it is difficult to stop the migration of Sri Lankan engineers to other developed countries one hundred percent, responsible engineering bodies like IESL and local engineering universities can develop platforms to share such expertise with local engineers and engineering undergraduates. Permanently migrated engineers can also be satisfied with such efforts by feeling that they have done something to the mother country without being debtors for having free education in Sri Lanka.

Due to the ease of migration to Australia temporarily through subclass visa of 376, a considerable number of just passed out Sri Lankan engineering graduates will try to migrate to Australia more and more in the future.

According to Figure 16 below, only 25.4% of respondents have recommended fresh engineering graduates to migrate to Australia, while 12.5% have not recommended. The majority of respondents (61.9%) have stayed neutral on recommendations.

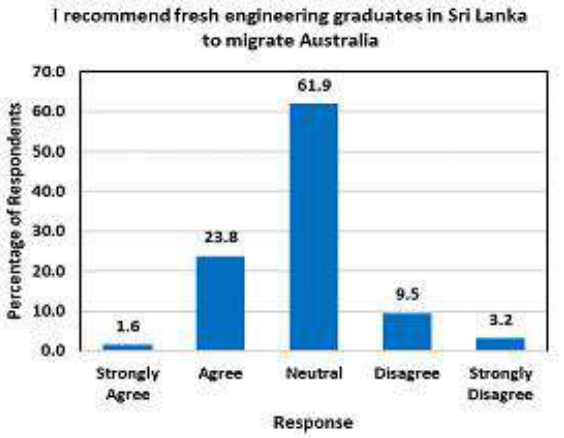

Figure 16: Recommendations on Migration to Australia

Therefore, fresh engineering graduates should search for more information on existing engineering opportunities in Australia and the PR process before migrating to Australia temporarily through subclass visa 376.

5. CONCLUSIONS

Several factors have caused the migration of young Sri Lankan engineers to Australia. Subclass visa 376 is the primary motivating factor to migrate to Australia. Aside from that, negative political influence and corruption, lower salaries, and poor working conditions in Sri Lanka are all strong motivators in that country. Professional growth and education opportunities and a desire to experience life in a foreign country are strong reasons to migrate to Australia. The majority of migrant engineers prefer the life they live in Australia. As a whole, Sri Lankans should take action to gain the benefits of brain drain by converting it into a brain gain.

Researchers used a convenient sampling strategy, so the study is an eye-opening look at young Sri Lankan engineers moving to Australia for better opportunities. Conducting quantitative research with a probability sampling strategy on the entire population helps to obtain generalizable results for migrant engineers.

If you want to dig deeper into any issues raised here, you could suggest an interview-based qualitative investigation.

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