ISSN 2522-9400 **European Modern Studies Journal** Vol 8 No 3
available at www.journal-ems.com
DOI: 10.59573/emsj.8(3).2024.21

Factors Contributing to Risk of SARS-CoV-2 Transmission in Two Specialized Centres in the Southern Province, Sri Lanka

Mathangaweera KJ[1], Rathnayake RMUK[2], Samanthi PHI[3], Vijayanthi HTAR[4], Hendawitharana GP[5]
[1]Base Hospital Tangalle, Sri Lanka
[2]District General Hospital, Matara, Sri Lanka
[3]New District Genaral Hospital Kamburugamuwa Sri Lanka
[4]Base Hospital Kamburupitiya, Sri Lanka
[5]District General Hospital, Matara, Sri Lanka

Abstract. *Introduction and objectives:* COVID-19 has had uneven impacts on health and well-being. Focusing on the experience of the Southern Province of Sri Lanka, this study describes the main factors influencing the transmission of SARS-CoV-2 among patients admitted to the New District General Hospital (NDGH) Kamburugamuwa and District General Hospital (DGH), Matara.

Methods: A prospective, cross-sectional descriptive study was conducted among 423 patients aged 18 years or older who were confirmed as COVID-19 positive by rRT-PCR test or rapid antigen test. Critically ill patients or oxygen-dependent patients at the time of data collection were excluded. Data were collected via phones using an interviewer-administered questionnaire. The categorical variables were analysed and presented as frequency distributions. The chi-squared test used to identify the association and $p<0.05$ was considered statistically significant.

Results: The response rate was 70.0% (296/ 423). A majority of the patients were in the age range of 36–55-years (n=92, 31.1%) and females (n=159, 53.7%). Most of the patients reported cough (n=191, 64.5%) followed by fever (n=176, 59.5%) and shortness of breath (SOB) (n=171, 57.8%). Cough (n=138, 46.6%), SOB (n=123, 41.6%) and runny nose (n=46, 15.5%) were more common in aged above 35 years compared to the aged 35 years or below ($p>0.05$). Most (n=211, 71.3%) consulted a healthcare provider following symptoms. A majority (n=77, 35.5%) of patients hardly practiced hand washing with soap and water for at least 20 seconds and maintained social distancing (n=75, 35.9%). Hypertension (n=52, 17.6%), diabetes mellitus (n=55, 18.6%) and cardiovascular disease (n=20, 6.8%) were more frequent in the > 35-year-olds patients. Increased risk of disease transmission was associated with contacts with an immediate family member ($p=0.000$), being a female ($p=0.001$), alcohol users ($p=0.013$) and active smoking ($p=0.005$).

Conclusions and recommendations: The advanced age, alcohol use, smoking, contact with an immediate family member and poor practice of protective measures increased the transmission of the disease. Therefore, it is essential to increase health literacy on hygienic practices in all communities.

Keywords: COVID-19, comorbidities, social factors

Introduction

Coronavirus disease-2019 (COVID-19) is a highly contagious disease that originated due to recently revealed severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2). It spreads person-to-person in several ways, yet primarily spreads through respiratory droplets (>10 μm) of exhaled virus from an infected person (within one meter apart) or contact surfaces (Sharma, Tiwari, Deb, & Marty, 2020). The disease affects people of all ages; however, evidence suggests that older people and people presented with other medical conditions are at

a higher risk of the disease and complications. Though a majority of patients presented with symptomatic (33% to 90%) or mild symptoms, some patients may present with adverse outcomes such as severe pneumonia, acute respiratory distress syndrome (ARDS), pulmonary oedema, septic shock, refractory metabolic acidosis, coagulopathy or multiple organ failure due to COVID-19 (Abul, Leeder, & Gravenstein, 2023). By 30th November 2023, there have been 772,052,752 confirmed cases of COVID-19, including 6,985,278 deaths worldwide (World Health Organisation (WHO), WHO Coronavirus (COVID-19) Dashboard, 2023).

The first confirmed COVID-19 case was reported on 27th January 2020 in Sri Lanka; however, by this date, the disease had been reported from 11 countries with 2798 confirmed cases and 80 deaths (Amaratunga, Fernando, Haigh, & Jayasinghe, 2020). On 30th January 2020, the World Health Organization (WHO) declared the outbreak a Public Health Emergency of International Concern (Harapan et al., 2020). Since the epidemic began, by 30th November 2023 Sri Lanka confirmed 672,629 cases and 16,886 deaths, thus, it causes a huge burden to the healthcare system (WHO, 2023. Global. Sri Lanka). The impact of COVID-19 has been distressing in Sri Lanka, with all districts being affected, with more cases observed in the districts of Colombo, Gampaha and Kalutara (Zhang, Dong, Liu, & Gao, 2023).

Parallel to other coronavirus infections, patients presented with COVID-19 have different clinical characteristics. Several patient characteristics are identified related to increased risk of a severe disease such as hypertension (Wu et al.), diabetes mellitus (DM) (Force et al., 2012; Simonnet et al., 2020), and obesity (Arents et al., 2020). Using an observational cross-sectional study approach, the current study aimed to describe factors influencing SARS-CoV-2 infection among patients admitted to two specialized centres in Southern Province, Sri Lanka. The data gathered from this study provided information to the treating physicians and health administrators to guide policy and implementation in preparedness for future similar pandemics.

Methods

This was a cross-sectional study conducted among patients over 18 years of age who were confirmed as COVID-19 positive by rRT- PCR test or rapid antigen test (RAT) admitted to the NDGH Kamburugamuwa and DGH, Matara. Both symptomatic and asymptomatic patients, who were able to communicate via telephone, without any physical and psychological difficulties and pregnant or lactating women were included. Critically ill patients or oxygen-dependent patients at the time of data collection were excluded from the study. The required sample size was calculated as 423 to detect an estimated population proportion of 50%; Z value of 1.96; precision of 5%; and non-response of 10% (Lwanga & Lemeshow, 1991). Using a nonprobability and consecutive sampling method, eligible patients giving informed written consent were recruited for the study, at the discharge desk or the ward just prior to the discharge. An attempt was made to collect data with minimal disturbance to them.

Data were collected using a pretested interviewer-administered questionnaire, which consisted of four sections: socio-demographic characteristics, clinical details, epidemiological history and behavioural practices. The questionnaire was designed after a detailed literature survey that considered studies conducted in developed as well as developing countries. It was subsequently reviewed by a panel of experts consisting of consultant community physicians and visiting physicians.

Data analysis was carried out using Statistical Package for Social Sciences (SPSS) software version 20. The categorical variables were described as frequencies and percentages. To assess the association between categorical variables the chi-square test was used and p-value <0.05 was considered statistically significant.

The study was carried out after obtaining ethical clearance from the Ethical Review Committee, Faculty of Medicine, University of Ruhuna.

Results

The study was carried out among 296 patients, giving a response rate of 70.0% (296/ 423). The majority were females (n=159, 53.7%) and belonged to 36–55-year age group (n=92, 31.1%) and one patient was pregnant with 12 -24 weeks of period of gestation. Most were married (n=237, 80.1%). Nearly half (n=160, 54.1%) completed the secondary education and majority engaged in full-time employment (n=28, 9.5%) (Table 1).

Table 1: Socio-demographic data of the patients

Characteristics	Male n (%)*	Female n (%)*	Total n (%)
Age category			
Less than 18 years	4 (2.9)	7 (4.4)	11 (3.7)
19-35 years	19 (13.9)	50 (31.4)	69 (23.3)
36-55 years	42 (30.7)	50 (31.4)	92 (31.1)
56-70 years	38 (27.7)	35 (22.0)	73 (22.0)
More than 70 years	34 (24.8)	17 (10.7)	51 (17.2)
The current relationship status			
Single	20 (14.6)	27 (17.0)	47 (15.9)
Engaged	0 (0.0)	6 (3.8)	6 (2.0)
Married	16 (84.7)	121 (76.1)	37 (80.1)
Divorced/ widowed	1 (0.7)	5 (3.1)	6 (2.0)
The highest level of education			
Primary education (Grade 1-5)	14 (10.2)	20 (12.6)	34 (11.5)
Secondary education (Grade 6-11)	82 (59.9)	78 (49.1)	160 (54.1)
Grade 12-13	29 (21.2)	54 (34.0)	83 (28.0)
Diploma/ Vocational training	5 (3.6)	1 (0.6)	6 (2.0)
Degree	6 (4.4)	5 (3.1)	11 (3.7)
Postgraduate	1 (0.7)	0 (0.0)	1 (0.3)
Current vocation			
Employed (fulltime)	25 (18.2)	3 (1.9)	28 (9.5)
Employed (part-time)	6 (4.4)	3 (1.9)	9 (3.0)
Self-employed (fulltime/part-time)	6 (4.4)	4 (2.5)	10 (3.4)
School child	8 (5.8)	0 (0.0)	8 (2.7)
Unemployed	6 (4.4)	15 (9.4)	21 (7.1)

**No. responded; percentage was calculated for total sample of 296*

Presence of chronic diseases and health-related behaviours are presented in Table 2.

Table 2: Presence of chronic diseases and health-related behaviours among patients

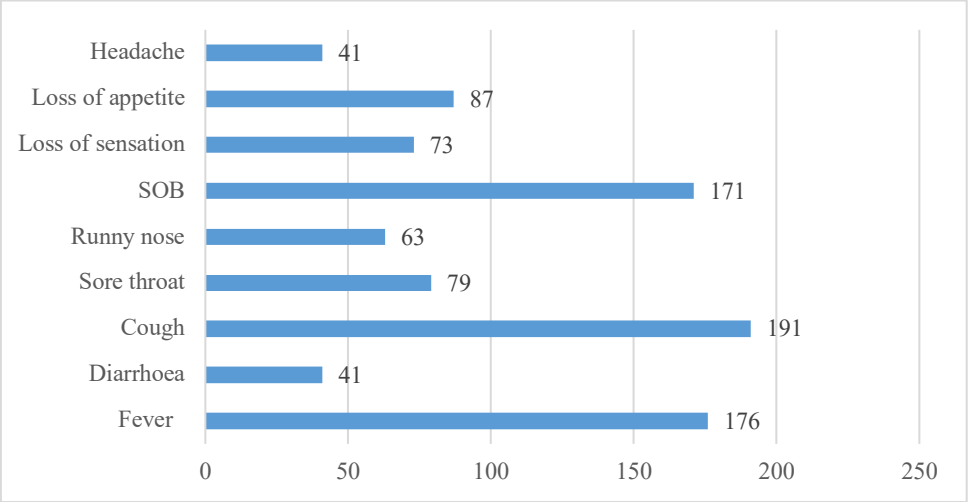
Characteristics	No. *	%**
Disease		
Hypertension	71	24.0
DM	76	25.7
Chronic kidney disease	14	4.7
Cancer	2	0.7
Cardiovascular disease	27	9.1
Other	84	28.4

Health-related behaviours		
Cigarette smoking	21	7.1
Use of alcohol	21	7.1

**One patient may have multiple disease ** percentage was calculated for total sample of 296*

Most patients presented with DM (n=76, 25.7%) followed by hypertension (n=71, 24.0%). Seven percent experience cigarette smoking or use of alcohol.

The symptoms among the patients are described in Figure 1.



**Several symptoms can be presented to a patient*

Figure 1: The symptoms among the patients (n=296)

Only one patient was asymptomatic. The most common presenting symptom is the fever (n=176, 59.5%) followed by SOB (n=171, 57.8%). A majority (n=116, 39.2%) presented with a contact history of immediate family member diagnosed with COVID-19 followed by contact with a known COVID-19 patient two weeks before symptoms (n=111, 37.5%). Patients presented with COVID-19 were inquired with their practices on protection of the disease and are described according to the gender in Table 3.

Table 3: Practices on protection of the disease (n=296)*

Practices	**Gender**	**Not at all (n, %)**	**Hardly practiced (n, %)**	**Somewhat practiced (n, %)**	**Frequently practiced (n, %)**	**p-value**
Washed hands with soap and water for at least 20 seconds	Male Female **Total**	13 (6.0) 5 (2.3) **18 (8.3)**	64 (29.5) 13 (6.0) **77 (35.5)**	31 (14.3) 38 (17.5) **69 (31.8)**	19 (8.8) 34 (15.7) **53 (24.4)**	**0.001**
Used disinfectants to clean hands	Male Female **Total**	69 (31.5) 18 (8.2) **87 (39.7)**	42 (19.2) 28 (12.8) **70 (32.0)**	11(5.0) 22 (10.0) **33 (15.1)**	5(2.3) 24 (11.0) **29 (13.2)**	**0.001**
Used antibiotics to prevent or treat COVID-19	Male Female **Total**	12 (5.5) 3 (1.4) **15 (5.1)**	62 (28.3) 15 (6.8) **77 (26.0)**	28 (12.8) 60 (27.4) **88 (29.7)**	22 (10.0) 17 (7.8) **39 (13.2)**	**0.002**
Disinfected the surfaces	Male Female **Total**	0 (0.0) 0 (0.0) **0 (0.0)**	42 (14.4) 10 (3.4) **52 (17.8)**	52 (17.8) 60 (20.5) **112 (38.4)**	41 (14.0) 87 (29.8) **128 (43.8)**	**0.000**

Avoided touching eyes, nose and mouth with unwashed hands	Male Female **Total**	3 (1.0) 0 (0.0) **3 (1.0)**	51 (23.5) 3 (1.4) **54 (24.9)**	55 (25.3) 40 (18.4) **95 (43.8)**	16 (7.4) 48 (22.1) **64 (29.5)**	**0.001**
Maintained social distance	Male Female **Total**	24 (11.5) 3 (1.4) **27 (12.9)**	62 (29.7) 13 (6.2) **75 (35.9)**	32 (15.3) 34 (16.3) **66 (31.6)**	8 (3.8) 33 (15.8) **41 (19.6)**	**0.003**
Stayed at home from work/school	Male Female **Total**	32 (15.4) 7 (3.4) **39 (18.8)**	62 (29.8) 25 (12.0) **87 (41.8)**	22 (10.6) 26 (12.5) **48 (23.1)**	10 (4.8) 23 (11.1) **33 (15.9)**	**0.001**
Wearing facemask	Male Female **Total**	1 (0.3) 0 (0.0) **1 (0.3)**	7 (2.4) 2 (0.7) **9 (3.0)**	68 (23.0) 35 (11.8) **103 (34.8)**	50 (16.9) 57 (19.3) **107 (36.1)**	**0.000**

**Percentage was calculated for total sample of 296*

A majority (n=77, 35.5%) of patients hardly practiced hand washing with soap and water for at least 20 seconds and maintain social distancing (n=75, 35.9%).

COVID-19 in young and middle-aged adults were compared and described in Table 4.

Table 4: Comparison of baseline characteristics on admission by age

Characteristics	**35 years or below**	**Above 35**	**p-value**
Gender (female)	57 (19.3%)	102 (34.5%)	**0.001**
Alcohol users	6 (2.0%)	15 (5.1%)	**0.013**
Active smoking	3 (1.0%)	18 (6.1%)	**0.005**
Hypertension	19 (6.4%)	52 (17.6%)	0.954
DM	21 (7.1%)	55 (18.6%)	0.891
CVD	7 (2.4%)	20 (6.8%)	0.892
Cancer	1 (0.3%)	1 (0.3%)	0.463
SOB	48 (16.2%)	123 (41.6%)	0.676
Cough	53 (17.9%)	138 (46.6%)	0.706
Runny nose	17 (5.7%)	46 (15.5%)	0.993
Contact with immediate family member	32 (27.6)	84 (72.4)	**0.000**

All comorbidities were more frequent in the ≥ 35-year-olds except for cancer. The statistical difference can be seen with gender (p=0.001), alcohol users (p=0.013), active smoking (p=0.005) and contacts with immediate family member (p=0.000). However, there were no differences can be seen in hypertensive, diabetic, cardiovascular or cancer patients (p>0.05). SOB (n=123, 41.6%), cough (n=138, 46.6%) and runny nose (n=46, 15.5%) were more common in above 35 years age category compared to 35 year or below age group (p>0.05).

Discussion

This study was conducted to describe the factors associated with transmission of COVID-19 in infected patients admitted the NDGH Kamburugamuwa and DGH Matara. A prospective, cross-sectional descriptive study was conducted to achieve the objectives. As we could not find any study related to our objectives in Sri Lanka, the findings of this study will help to identify the factors associated with transmission of the COVID-19. Further, the methodology of this study can be used for conducting the studies in future in other pandemics.

The overall response rate of this study was 70.0% (296/ 423). If the number of nonresponses is unequal or statistically significant difference with respondents, it causes sampling bias threatening the internal validity. In addition to the advantage with the setting of NDGH Kamburugamuwa and DGH Matara, several other factors may have contributed to the high response rates. Face-to-face recruitment as a substitute of a less personal form of contact between the data collector and the participants could increase the participation rate, however, due to disease transmission, we could not practice a face-to-face interview and instead of it, telephone conversation was carried out (Bongers & Van, 1998). The used interviewer-administered questionnaire was pre-tested among ten patients who did not participate in the study and the average length of time taken to complete the questionnaire was 15 minutes, thus, the study instrument was suitable in collecting data.

A majority of the patients in the current study was female (n=159, 73%). A previous study conducted in Sri Lanka (n=335, 78%) and Canada (n=495, 61.0%) reported the male preponderance (Herath et al., n.d; Murthy et al., 2021). Further, a study conducted in Spain where one of the hardest hit countries in Europe reported that women had more responsible attitude toward the COVID-19 pandemic than men, which lead to COVID-19 common in males (De La Vega, Ruíz-Barquín, Boros, & Szabo, 2020). This could be due to practice of preventive measures such as frequent hand washing, wear a facemask, and stay at home common in females compared to males. In our study female preponderance could be due to female predominant roles as caregivers within families and as frontline health care and community workers that expose them to a high risk of infection (. At home, women play a major role in household work, including child caring and caring of sick family members (Bahn, Cohen, & van der Meulen Rodgers, 2020). In our study, a majority (n=116, 39.2%) presented with a contact history of immediate family member diagnosed with COVID-19 and those patients could be looked after by a female in the family. Thus, these factors could lead to a greater infection risk in women than in men in our study. The most of the patients were in the age range of 36-55 years (n=92, 31.1%) in the current study. Compatible to that previous study conducted in Sri Lanka reported the mean age of the patients as 37.1±13.2 years (Herath et al., n.d).

Most patients presented with DM (n=76, 25.7%) followed by hypertension (n=71, 24.0%) in the current study. Further, study included 1099 patients in China with confirmed COVID-19, 23.7% presented with hypertension (23·7%), 16.2% with DM (Guan et al., 2020). In another study in China, of 140 patients who were admitted to hospital with COVID-19, 30% had hypertension and 12% had DM (Zhang et al., 2020). SARS -CoV 2 bind to their target cells through angiotensin-converting enzyme 2 (ACE2), which is expressed by epithelial cells of the lung, intestine, kidney, and blood vessels (Wan, Shang, Graham, Baric, & Li, 2020). These ACE2 is common in patients with DM and hypertension, who are treated with ACE inhibitors and angiotensin II type-I receptor blockers (ARBs). Subsequently, the increased expression of ACE2 would facilitate infection with COVID-19. Thus, patients with DM or hypertension treated with ACE2-stimulating drugs increases the risk of developing severe and fatal COVID-19.

The period between 27/01/2020 to 03/10/ 2020 was considered as the first wave of COVID-19. During this period, 3396 COVID-19 cases were reported with 13 deaths in Sri Lanka. The case fatality was 0.38 in this first wave. In second wave the case number increased gradually and at the end of the second wave (14/04/2021) total number of COVID-19 positive cases were increased up to 92341 with 591 deaths (Epidemiology Unit. Ministry of Health, 2023) . Due to high caseload in this period, health authorities established different categories of COVID-19 Management centres in Sri Lanka. Those were categorized as level 1, level 2 and level 3 centres. NDGH Kaburugamuwa was the level 2 centre with bed capacity of 236 and only female patients were treated and male patients were treated at DGH Matara. Mild to

moderate symptomatic patients were managed in these centres, as there were medical consultants to manage on a permanent or temporary basis. Therefore, we noticed the most patients presented with fever (n=176, 59.5%) followed by SOB (n=171, 57.8%) and no severe symptoms reported in our study. However, a study done in Sri Lanka previously, reported sore throat (n=81, 19.0%) as the most common symptom followed by cough (n=72, 17%) and headache (n=72, 17%) (Herath et al., (n.d). Further, national cohort study conducted in Canada reported fever (73.7%) as the commonest symptom followed by SOB (67.1%), fatigue/malaise (43.3%), cough (48.6%) and diarrhoea (26.1%) on admission (Murthy et al., 2021). Fever common among patients above 35 years (n=128, 43.2%) in our study though it was not statistically significant (p=0.908). It is consistent with the previous study showing that the older group (≥60 years) had a higher rate of SOB than the younger group (<60 years) (Lian et al., 2020). This could be due to the presence of comorbidities with age, including hypertension, coronary heart disease, chronic obstructive pulmonary disease and DM.

A majority (n=116, 39.2%) presented with a contact history of immediate family member diagnosed with COVID-19 followed by contact with a known COVID-19 patient two weeks before symptoms (n=111, 37.5%). It is clear that family clusters were common in the spread of the disease. Family members who shared a similar exposure history could have cross infection with each other. Further, patients exposed to a known patient with COVID-19 symptom, which leads to significant correlations of clinical and imaging features between them.

A majority (n=77, 35.5%) of patients hardly practiced hand washing with soap and water for at least 20 seconds and maintain social distancing (n=75, 35.9%). Further, 36.1% (n=107) frequently wear facemask. It showed that adherence to wearing face mask in public places and performance of hand hygiene is not optimum in the study population. Additionally, male less frequently practice of wearing facemask (n=50, 16.9%) compared to female (n=57, 19.3%) (p=0.000). Also, a study done elsewhere found that males were less likely to wear face covering than females which could be due to males consider wearing them as shameful and a sign of weakness. When the disease progress in Sri Lanka face masks, face shields and hand sanitizers were readily available for purchase in virtually all shops from street corner shops to large departmental shops. However, some people face difficulty in purchasing due to cost. Additionally, handwashing is a simple and primary preventive measure that can practice by any person, yet, some could not practice which could be explained by poor attitudes. A much higher level of adherence could observe following the availability of hand hygiene stations and were made prerequisites for entering the shops. Furthermore, people used facemask when the government made it compulsory. Regarding the use of alcohol-based hand rubs, it was not practicable if the person applied them into the palm of their hands and immediately enter to the common places. The association, of using facemask, handwashing and use of disinfections were significant in the bivariable analysis among both sexes (p=0.001). Moreover, reviews of studies have shown that reducing the frequency of touching surfaces by hands and disinfecting surfaces can reduce the amount of coronavirus load on surfaces and the rate of transmission. The most important solution is to disinfect surfaces, clean surfaces with water and detergents, and then disinfect with ethyl alcohol (62–71%), or hydrogen peroxide (0.5%), or sodium hypochlorite (0.1%) with 1 min contact time (WHO, COVID-19 pandemic, 2023).

In order to bring the new coronavirus pandemic in the country under control, the government of Sri Lanka implemented a set of control strategies including social distancing, quarantine, lockdowns, travel restrictions and isolation of villages. Our results suggest that information dissemination about COVID-19, which causes individual adoption of handwashing, mask-wearing, and social distancing, which could be effective strategies to mitigate and delay the epidemic. Early initiated short-term government-imposed social distancing can buy time for healthcare systems to prepare for an increasing COVID-19 burden.

We stress the importance of disease awareness in controlling the ongoing epidemic and recommend that, in addition to policies on social distancing, governments and public health institutions mobilize people to adopt self-imposed measures with proven efficacy in order to successfully tackle COVID-19 (Teslya et al., 2020).

In this descriptive cross-sectional study, we were unable to assess a causal association or relationship between a risk factor and the disease. Though, we used an interviewer-administered questionnaire, due to high transmission of the disease, telephone conversation was made to collect the details, which might affect the true answers. Direct observation of practice is an evaluation tool where participants are exposed to a real or simulated situation and must interact with it in real-time, however, it could not asses in our study.

Conclusions and Recommendations

The advanced age, alcohol use, smoking, contact with immediate family member and poor practice of protective measures increased the transmission of the disease. Therefore, it is essential to increase health literacy on hygienic practices in all communities. Preventive and control measures of non-communicable diseases is needed to reduce to disease transmission.

Author Declarations

Competing Interests

The authors declare that they have noncompeting interests.

Ethics Approval and Consent to Participate

Ethics clearance was obtained from the Ethics Review Committee of the Faculty of Medicine, University of Ruhuna. Written authorization was obtained from the Director DGH Matara and NDGH Kaburugamuwa and informed written consent from the participants.

Funding

Self-funded.

Acknowledgements

The authors acknowledge the Director, NDGH Kaburugamuwa, DGH Matara and their staff and the patients who participated in the study.

References

Abul, Y. Leeder, C. & Gravenstein, S. (2023). Epidemiology and clinical presentation of COVID-19 in older adults. *Infectious Disease Clinics, 1, 37*(1), 1-26.

Amaratunga, D. Fernando, N. Haigh, R. & Jayasinghe, N. (2020). The COVID-19 outbreak in Sri Lanka: A synoptic analysis focusing on trends, impacts, risks and science-policy interaction processes. *Progress in Disaster Science, 8*, 100133.

Arentz, M. Yim, E. Klaff, L. Lokhandwala, S. Riedo, F. X. Chong, M. & Lee, M. (2020). Characteristics and outcomes of 21 critically ill patients with COVID-19 in Washington State. *JAMA, 323*(16), 1612-4.

Bahn, K. Cohen, J. & van der Meulen Rodgers, Y. (2020). A feminist perspective on COVID-19 and the value of care work globally. *Gender, Work & Organization, 27*(5), 695-9.

Bongers, I. M. & Van Oers, J. A. (1998). Mode effects on self-reported alcohol use and problem drinking: mail questionnaires and personal interviewing compared. *Journal of Studies on Alcohol, 59*(3), 280-5.

De La Vega, R. Ruíz-Barquín, R. Boros, S. & Szabo, A. (2020). Could attitudes toward COVID-19 in Spain render men more vulnerable than women? *Global Public Health, 15*(9), 1278-9.

Epidemiology Unit. Ministry of Health. COVID-19 Epidemiology Sri Lanka. (2023). Retrieve from https://www.epid.gov.lk/storage/post/pdfs/en_6401f1862b0cb_esummery-december.pdf.

Force, A. D. Ranieri, V.M. Rubenfeld, G. D. Thompson, B.T. Ferguson, N. Caldwell, E. Fan, E. Camporota, L. & Slutsky, A. S. (2012). Acute respiratory distress syndrome. *JAMA, 307*(23), 2526-33.

Gebhard, C. Regitz-Zagrosek, V. Neuhauser, H. K. Morgan, R. & Klein, S. L. (2020). Impact of sex and gender on COVID-19 outcomes in Europe. *Biology of Sex Differences, 11*, 1-3.

Guan, W. J. Ni, Z. Y. Hu, Y. Liang, W.H. Ou, C. Q. He, J.X. Liu, L. Shan, H. Lei, C.L. Hui, D.S. & Du, B. (2020). Clinical characteristics of coronavirus disease 2019 in China. *New England Journal of Medicine, 382*(18), 1708-20.

Harapan, H. Itoh, N. Yufika, A. Winardi, W. Keam, S. Te, H. Megawati, D. Hayati, Z. Wagner, A. L. & Mudatsir, M. (2020). Coronavirus disease 2019 (COVID-19): A literature review. *Journal of Infection and Public Health, 13*(5), 667-73.

Herath, M., Acharige, T.A., June, B.P., Hettiarachchi, N. M., Dona, T. D., Mudiyanselage, P.L., Senevirathne, N. B., Bhishman, S., Jayawardhana, A.G., Balasooriya, P., & Thushanthy, P. (2020). Clinical and epidemiological characteristics and outcome of patients with COVID-19 in Sri Lanka; an observational study.

Lian, J. Jin, X. Hao, S. Cai, H. Zhang, S. Zheng, L. Jia, H. Hu, J. Gao, J. Zhang, Y. & Zhang, X. (2020). Analysis of epidemiological and clinical features in older patients with coronavirus disease 2019 (COVID-19) outside Wuhan. *Clinical Infectious Diseases, 71*(15), 740-7.

Lwanga, S. K. & Lemeshow, S. (1991). *World Health Organization. Sample size determination in health studies: a practical manual.* World Health Organization.

Murthy, S. Archambault, P. M. Atique, A. Carrier, F. M. Cheng, M. P. Codan, C. Daneman, N. Dechert, W. Douglas, S. Fiest, K. M. & Fowler, R. (2021). Characteristics and outcomes of patients with COVID-19 admitted to hospital and intensive care in the first phase of the pandemic in Canada: a national cohort study. *Canadian Medical Association Open Access Journal, 9*(1), E181-8.

Sharma, A. Tiwari, S. Deb, M, K. & Marty, J. L. (2020), Severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2): a global pandemic and treatment strategies. *International Journal of Antimicrobial Agents, 56*(2), 106054.

Simonnet, A. Chetboun, M. Poissy, J. Raverdy, V. Noulette, J. Duhamel, A. Labreuche, J., Mathieu, D., Pattou, F., & Jourdain, M. (2020). LICORN and the Lille COVID-19 and Obesity Study Group. High prevalence of obesity in severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) requiring invasive mechanical ventilation. *Obesity, 28*(7), 1195-9.

Teslya, A. Pham, T. M. Godijk, N. G. Kretzschmar, M. E. Bootsma, M. C. & Rozhnova G. (2020). Impact of self-imposed prevention measures and short-term government-imposed social distancing on mitigating and delaying a COVID-19 epidemic: A modelling study. *PLoS Medicine, 17*(7), e1003166.

Wan, Y. Shang, J. Graham, R. Baric, R. S. & Li, F. (2020). Receptor recognition by the novel coronavirus from Wuhan: an analysis based on decade-long structural studies of SARS coronavirus. *Journal of Virology, 94*(7), 10-128.

World Health Organization. Coronavirus disease (COVID-19) pandemic. (2023). Retrieved from https://www.who.int/emergencies/diseases/novel-coronavirus-2019?

adgroupsurvey={adgroupsurvey}&gclid=Cj0KCQiAsvWrBhC0ARIsAO4E6f9lrrNACzDMaPplNwWfMlwwx2NDcwn26uhFvKoiMQXIHwXySLXFzIIaAlQHEALw_wcB.

World Health Organization. Global. Sri Lanka. (2023) Retrieve from https://covid19.who.int/region/searo/country/lk.

World Health Organization. WHO Coronavirus (COVID-19) Dashboard. (2023). Retrieve from https://covid19.who.int/?adgroupsurvey={adgroupsurvey}&gclid=CjwKCAiApaarBhB7EiwAYiMwqkyH0KtF22PZkSwEyCIhaVkKFMHg3XONRzTed65fiTwkn3th5j5ztRoCZKcQAvD_BwE.

Wu, C. Chen, X. Cai, Y. Xia, J. Zhou, X. Xu, S. Huang, H. Zhang, L. Zhou, X. Du, C. & Zhang, Y. Risk factors associated with acute respiratory distress syndrome and death in patients with coronavirus disease 2019 pneumonia in Wuhan, China. *JAMA Internal Medicine, 180*(7), 934-943.

Zhang, J.J. Dong, X. Cao, Y. Y. Yuan, Y. D. Yang, Y. B. Yan, Y. Q. Akdis, C.A. & Gao, Y.D. (2020). Clinical characteristics of 140 patients infected with SARS-CoV-2 in Wuhan, China. *Allergy, 75*(7), 1730-41.

Zhang, J.J. Dong, X. Liu, G. H. & Gao, Y. D. (2023). Risk and protective factors for COVID-19 morbidity, severity, and mortality. *Clinical Reviews in Allergy & Immunology, 64*(1), 90-107.