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Author: Eirene Ecclesia Harold, Dr. Michelle Benedict

Business Management School, Sri Lanka

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**INFLUENCE OF COVID-19 ON MENTAL AND BEHAVIOURAL CHANGES IN  
STUDENTS OF TERTIARY EDUCATION SYSTEM BETWEEN AGES 20-35 AND  
ITS PROBABLE LONG-TERM IMPACT ON THE FUTURE AT A LEVEL OF  
CLINICAL SIGNIFICANCE**

Eirene Ecclesia Harold, Dr. Michelle Benedict

*School of Science, Business Management School, Sri Lanka*

**ABSTRACT**

The outbreak of COVID-19 has had a global impact on the world and has posed an unprecedented challenge to the human in almost every aspect of life including behavioural and mental changes. All of us have been affected by the current pandemic; however, its impact and consequences are felt differently depending on our role as individuals of different human developmental stages in society. It is difficult to transform or adapt quickly to the sudden changes happening around us due to the ongoing crisis. The most affected life stage is early adulthood which is comprised of mostly students in the tertiary education system. It is one of the most peak stages for several psychological disorders. COVID-19 pandemic posed novel and more difficult challenges (radical shift to virtual online learning, loss of social interaction due to social isolation, financial issues to the extent of jeopardising the education etc...) to the students apart from the usual academic and transitional stressors. There are chances for a greater extent for these changes to have a long-lasting impact, in terms of mental and physical health, and a higher risk for these problems to progress into clinical conditions.

This research was based on a survey using a questionnaire that emphasized the mental parameters such as anxiety, depression, threat perception, emotional, self-concept and, behavioural parameters such as sleep, physical activity, eating

habits, socializing and weight management among students aged 20-35 in the tertiary education system, and their probable impact in the future at a level of clinical significance.

Keywords: COVID-19, young adults, mental health, physical health, clinical conditions

**INTRODUCTION**

Human civilization is passing through the most catastrophic juncture of this millennium, with the advent of the novel severe acute respiratory syndrome coronavirus (SARS-Cov-2) rapidly invading the regions worldwide. World Health Organization reports more than 239 million confirmed cases of COVID-19 as of 15 October, 2021 with more than 4 million deaths and nearly 6 billion vaccine doses have also been administered as of 13 October, 2021 (WHO, 2021). Many studies suggested that COVID-19 have had a significant influence on people's mental health and behaviour (Loades et al., 2020; Luo et al., 2020; Machado et al., 2020; Silva et al., 2020; Vindegaard and Benros, 2020). There are just a few studies suggesting otherwise (Gijzen et al., 2020). It was found that people aged between 18-29 years had greater psychological distress showing the greatest deterioration than other age groups in Johns Hopkins COVID-19 Civic Life and Public Health Survey in the USA

(McGinty et al., 2020), likewise in another survey in the UK, found out the same, that 18-24-year-olds had greater mental distress (Pierce et al., 2020).

Past pandemics, such as Severe Acute Respiratory Syndrome (SARS) and H1N1 influenza brought long-term consequences on mental health and even increased the risk of chronic illnesses such as heart disease and diabetes (Cheung, Chau and Yip, 2008; Mazumder et al., 2009). Chronic diseases or non-communicable diseases (NCDs) are long-term illnesses caused by a range of genetic, physiological, environmental and behavioural factors; NCDs account for 71% of deaths worldwide (WHO, 2021). People in low- and middle-income nations are disproportionately affected by NCDs (Kazibwe, Tran and Annerstedt, 2021); given that, according to World Bank, majority of them (75%) live in these countries (Prydz and Wadhwa, 2019). The current outbreak has significantly impacted the whole world negatively compared to past pandemics with changed behavioural and mental parameters; hence COVID-19 can probably have a long term impact on the future at a level of clinical significance. Sleep is imperative for survival and for physical, cognitive and psychological processes (Léger et al., 2014). Less than 7 or more than 9 hours of sleep for a chronic period can bring adverse effects to health (Chaput, Dutil and Kanyinga, 2018). According to a 12-year prospective analysis, people with short sleep duration and low sleep quality had a 63% risk of cardiovascular disease (CVD) and 79% of coronary heart disease (CHD) (Hoevenaer-Blom et al., 2011).

Physical activity proves to be an essential factor that can have beneficial effects for NCDs and Alzheimer's disease because physically active people have a decreased risk of cognitive impairment (Reiner et al., 2013). Alzheimer's disease is the most common neurodegenerative disease and has been the principal cause of

dementia in older people (Shi, Sabbagh and Vellas, 2020). Physical inactivity can lead to chronically increased levels of cholesterol (dyslipidemia) because physical activity has been shown to decrease the levels of low-density lipoprotein (LDL) and triglycerides while increasing the levels of high-density lipoprotein (HDL) (Mann, Beedie and Jimenez, 2013). Excessive physical activity can lead to Overtraining Syndrome (OTS) resulting in mood disturbances and problems in body systems (Kreher and Schwartz, 2012). Exertional rhabdomyolysis (ER) is also caused by strenuous exercise; characterized by muscular breakdown, increase/decrease in blood creatine kinase levels and the presence/absence of myoglobinuria (Sunder et al., 2019).

Sedentary behaviour is known to involve behaviours with low-energy expenditure tasks ranging from 1.0-1.5 METs (metabolic equivalent of tasks) (Owen et al., 2010). Sedentary lifestyle and low physical activity have been linked to Type 2 Diabetes (T2D) in several studies (Brugnara et al., 2016; Joseph et al., 2016; McFarlane et al., 2018). People with sedentary lifestyle are also at 30% higher risk of colon cancer as hyperinsulinism or insulin resistance may accelerate the development of colonic cancer cells (Cong et al., 2013). Digital eye strain or computer vision syndrome (CVS) is a condition caused by visual disturbances or ocular discomfort including defocus, accommodation dysfunction and fixation disparity due to usage of digital devices (Brennan, Sulley and Young, 2019). According to a study, CVS was shown to be prevalent in 94.5% of university students with tears being the common symptom (59%) (Gammoh, 2021).

Food-borne contaminants represent a health hazard to the general population. Plasticizers like phthalate esters are known for their anti-androgen and

estrogen-like properties (Toni et al., 2017). Prenatal exposure to phthalates could interrupt the levels of thyroid, sex hormones and 25-hydroxyvitamin D in pregnant women resulting in preeclampsia, maternal glucose disorders, infant cryptorchidism/hypospadias and preterm birth (Qian et al., 2020). Monoethylhexyl phthalate (MEHP) can bind to hER $\alpha$ , $\beta$ , causing estrogenic or anti-estrogenic actions (Giuliani et al., 2020). Furthermore, higher dosages of monoethyl phthalate (MEP) or MEHP are associated with decreased serum free thyroxine (Wang et al., 2018). There appears to be a link between refined sugar (fructose) intake and Non-Alcoholic Fatty Liver Disease (NAFLD); moreover, soft drinks are high in advanced glycation end products causing insulin resistance and aggravate liver damage, leading to steatohepatitis to fibrosis (Gómez, Sagi and Trenell, 2017). Hepatic manifestation of metabolic syndrome characterized by the build-up of liver fat of >5% in the absence of considerable alcohol use, viral infection, or any other particular cause of liver disease is known as NAFLD; it is commonly associated with, insulin resistance, dyslipidemia and obesity and the incidence of NAFLD is on the ascent due to rising obesity and diabetes rates throughout the world (Orzi et al., 2016). Most Severe Obstructive Sleep Apnea (OSA) appears to be linked to the predilection for calorie-dense food that is high in fat and carbohydrates regardless of the degree of obesity (Beebe et al., 2011). The risk of dementia and Alzheimer's disease is elevated with increased afternoon-snack glycaemic load (GL) and in APOE (Apolipoprotein E)- $\epsilon$ 4 allele carriers (Gentreau et al., 2020). In obesity, there is an elevated level of circulating leptin (appetite suppressant) due to excess body fat mass, indicating leptin resistance where increased levels of leptin are necessary to overcome the malfunction in the leptin signalling cascade; in obese

people, calorie restriction-induced fat loss generates compensatory mechanisms that favour lost fat recovery with increased appetite and metabolic efficiency (Guyenet and Schwartz, 2012). Obesity has been frequently linked to gallstone disease (Bonfrate et al., 2014; Housset, 2018). Conversely, being underweight can cause anaemia (Gautam et al., 2019). Low carbohydrate consumption in diet plans such as in Ketogenic diets, often known as very low carbohydrate ketogenic diets (VLCKDs), limit carbohydrate consumption to <50 grams per day and there is also vitamin and mineral deficiencies, with daily potassium deficiency and high protein content resulting in net metabolic acidosis (Cordain, 2018). Vitamin D levels may be worsened during this pandemic, especially for people living in Northern latitudes, because indoor life has increased with quarantine hence, our body gets restricted amount of sunlight so it could further increase the risk of developing bone diseases in the future (New et al., 2020).

Reduced social interaction due to social distancing and isolation can negatively influence subjective well-being (De Vos, 2020; De Vos et al., 2013; Ettema et al., 2010). This isolation leads to decreased social engagement and self-development with increased stress and depression (Brooks et al., 2020). Psychosocial stress triggers the hypothalamic-pituitary-adrenal axis and autonomic nervous system by impacting the endocrine and immune systems (Nausheen et al., 2010). This leads to an environment that is conducive for tumour pathogenesis (Lutgendorf and Sood, 2011). Low socializing can cause reduced gut microbiome which is linked to inflammatory bowel disease (Nguyen et al., 2021). When anxious, body releases stress-related hormones into the gut making it more sensitive and inflammatory, leading to abdominal discomfort, changes in microbiota, and

irregular bowel movements resulting in inflammatory bowel syndrome (IBS) (Kennedy, 2014). Anxiety and depression are also related to insomnia and excessive daytime sleepiness (Dauvilliers et al., 2013).

Self-concept is recognized to be a multidimensional construct comprising of emotional, physical, academic and social dimensions; its evaluative component is commonly described as self-esteem (Lázaro et al., 2017). Low self-esteem is among the risk factors for the development of eating disorders such as anorexia/bulimia nervosa and binge eating disorder (Mora et al., 2017). Stress can be caused due to low socioeconomic status (low ses), work, anxiety and depression (figure 1) which are currently very common due to the pandemic. Stress increases cortisol levels and reduces its normal diurnal variability causing build-up of visceral fat by proliferation and differentiation of adipocytes as fat redistribution takes place increasing the size/number of adipocytes leading to central obesity; lipolysis occurs releasing free fatty acids causing insulin resistance which are most likely mediated by glucocorticoid receptors found more in visceral adipose tissue than in subcutaneous adipose tissue; therefore elevated cortisol levels cause visceral obesity and insulin resistance which are metabolic precursors to diabetes; moreover, subclinical hypercortisolism might be another biological link for the relationship between depression and T2D (Joseph and Golden, 2016).

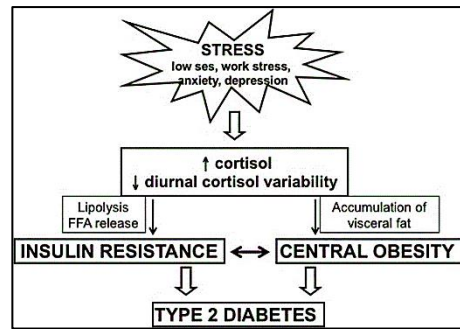


Figure 1: The link between stress, central obesity and T2D (Joseph and Golden, 2016)

## METHODOLOGY

The online survey was organized and conducted by using a questionnaire which was prepared using Google forms in three languages (English, Sinhala and Tamil) respectively. To ensure data confidentiality, the questionnaire was made anonymous. The questions that were asked are given in Table 1 and Table 2 with the participants' demographic questions being omitted. The questionnaire was sent through WhatsApp, Messenger and Instagram to family members, friends, acquaintances to reach a wider number of participants and only the targeted group of students who were 20-35 years old in the tertiary education system were surveyed. The number of participants was 130 students. The period of the data gathering was from July 8, 2021 to July 15, 2021. The questionnaire consisted of 34 questions. The first section of the questionnaire collected information on participants' demographics (age, gender, country, city, religion, profession, civil status and lifestyle). Finally, an optional open-ended, short-answer question was used for an exploratory purpose. Answers to these questions were directed to the changes in a specific mental and behavioural parameter. The students in each age

group/level of tertiary education, they are in at the time of the survey were clustered together to find the impact, COVID-19 have had on them behaviourally and

mentally, and the probable clinical conditions they may develop in the future.

Table 1. Questionnaire of behavioural parameters

Behavioural Parameters	Questions	Answers		
leep	Have your sleeping time increased/decreased, during the pandemic compared to pre-COVID-19?	Increased	Decreased	No change
	Has your quality of sleep been affected negatively (anxious, not peaceful, worried about tomorrow etc...)?	Severely affected	Mildly affected	Not at all
Physical Activity	How many times did you exercise before the pandemic?	<4 times a week	Everyday	Never
	How many times do you exercise now?	<4 times a week	Everyday	Never
	By how many hours have your sitting time/screen time, increased/decreased?	Increased by 1-4 hours	Decreased by 1-4 hours	No change
Eating Habits	Has the current pandemic encouraged you to eat more healthy food?	Very much /	Slightly	No change
	Have your consumption of confectionaries (chocolates, candy, sweets) increased/decreased during COVID-19?	Increased	Decreased	No change
	Have your consumption of carbohydrates (bread, string hoppers, chapati etc...) increased/decreased during COVID-19?	Increased	Decreased	No change
Socializing	Have you avoided going outside to meetups, hangouts, party or any other outdoor activity?	Fully avoided	Somewhat avoided	Not at all
	Have you limited your physical interaction with people (hugging, maintaining distance, shaking hands etc...)?	Of course	Quite limited	No

Weight management	Have your weight increased/decreased during the pandemic?	Increased	Decreased	No change
	Are you satisfied with the amount of food you consume?	Highly satisfied	Kind of satisfied	Not at all

Table 2. Questionnaire of mental parameters

Mental Parameters	Questions	Answers		
Anxiety	Are you anxious about COVID-19 and its impact on your life?	Very anxious	Quite anxious	Not at all
	Do you feel anxious when a family member/ roommate go outside the house?	Very anxious	Quite anxious	Not at all
Depression	Do you get depressed when you hear the things happening in the country/ hear the news?	Very depressed	Quite depressed	Not at all
	Have you been depressed because of a death of a relative, friend, neighbour, celebrity etc...?	Very depressed	Quite depressed	Not at all
Threat Perception	How likely do you think you will contract the novel coronavirus infection?	Very likely	Chances are minimal	Never
	Do you fear visiting relatives, acquaintances and friends?	Absolutely	Quite scared	Not at all
Emotional	Do you think this ongoing crisis will come to an end?	Definitely	Not sure (equal chances-end/not end)	No, we have to adjust to live with it
	Have your motivation to study increased/decreased due to the pandemic?	Increased	Decreased	No change
Self-concept	Do you think you exist as "separate from others" during this pandemic?	Yes, I am highly privileged than others	No, all are equal	Yes, I am underprivileged than others
	Has this outbreak made you doubt your self-esteem?	Very much	Sometimes	Not at all

Link to the questionnaire (form closed):

[https://docs.google.com/forms/d/e/1FAIpQLSfAsAEN1G3NVveqqA6iLvr0TCrB7Tc\\_OAQJ-ic8DLkp11rVFg/viewform](https://docs.google.com/forms/d/e/1FAIpQLSfAsAEN1G3NVveqqA6iLvr0TCrB7Tc_OAQJ-ic8DLkp11rVFg/viewform)

## RESULTS

Table 3 and Table 4 are constructed based on the number of responses for each

question under mental and behavioural parameters from a targeted population of ages 20-35 who are in the tertiary education system.

Table 3. Responses for behavioural parameters

Behavioural Parameters	Questions	Responses		
Sleep	Duration of sleep?	Increased	Decreased	No change
	No of responses	69	34	27
	Quality of sleep?	Severely affected	Mildly affected	Not at all
	No of responses	20	75	35
Physical Activity	Exercise before pandemic?	<4 times a week	Everyday	Never
	No of responses	44	20	66
	Exercise now?	<4 times a week	Everyday	Never
	No of responses	37	32	61
	Sitting/screen time?	Increased by 1-4 hours	Decreased by 1-4 hours	No change
	No of responses	106	08	16
Eating habits	Healthy food?	Very much	Slightly	No change
	No of responses	37	63	30
	Confectionaries?	Increased	Decreased	No change
	No of responses	54	21	55
	Carbohydrates?	Increased	Decreased	No change
	No of responses	59	21	50
Socializing	Avoided outdoor activity?	Fully avoided	Somewhat avoided	Not at all
	No of responses	71	53	6
	Limited interaction?	Of course	Quite limited	No
	No of responses	65	52	13
Weight management	Weight?	Increased	Decreased	No change
	No of responses	58	30	42
	Satisfaction of food?	Highly satisfied	Kind of satisfied	Not at all
	No of responses	54	63	13



Table 4. Responses for mental parameters

Mental Parameters	Questions	Responses		
Anxiety	Impact of COVID-19?	Very anxious	Quite anxious	Not at all
	No of responses	55	60	15
	Anxious when a family member/ roommate go outside?	Very anxious	Quite anxious	Not at all
	No of responses	29	74	27
Depression	Hear news about things happening around?	Very depressed	Quite depressed	Not at all
	No of responses	51	66	13
	Death?	Very depressed	Quite depressed	Not at all
	No of responses	46	51	33
Threat perception	Contract COVID-19?	Very likely	Chances are minimal	Never
	No of responses	27	90	13
	Fear visiting?	Absolutely	Quite scared	Not at all
	No of responses	17	70	43
Emotional	Motivation to study?	Increased	Decreased	No change
	No of responses	25	66	39
	Will COVID-19 end?	Definitely	Not sure (equal chances-end/not end)	No, we have to adjust to live with it
	No of responses	23	55	52
Self-concept	Exist “separate from others”?	Yes, I am highly privileged than others	No, all are equal	Yes, I am underprivileged than others
	No of responses	24	97	9
	Doubt self-esteem?	Very much	Sometimes	Not at all
	No of responses	18	79	33

Table 5. Additional responses of participants

Any additional information pertaining to the impact of COVID you would like to share?
The whole university life experience has been missed due to the pandemic, though we are learning through online platforms, no keen interest to actively engage in studies.
During this time, you are stuck with yourself and you would have to face a lot of personal issues with yourself that you've been running away from, amidst solving those, you become more aware of yourself, helping you to practice gratitude and finding the positives in the middle of all the negatives around us.
Most of us have been impacted negatively by COVID-19. This pandemic period has caused negative emotions due to less/no income, travel restrictions and online education. It has affected people's mental and physical health badly.
This pandemic has caused more depression for most of the students since they will not be able to go out of the house. Moreover, when it comes to education, students feel they are not interacting with the lecturers like before.
COVID-19 pandemic has greatly affected all age groups and students are under great stress to swap into the method of online education which is new to Sri Lanka.
We have to challenge this, continue our works and achieve our goals.
COVID-19 taught us some good things but it has done bad things.
COVID-19 has caused a huge negative impact on the economy and its development.
We should be responsible enough to save us and all living around us.
Listen to government COVID-19 restriction rules and obey them.
Online learning is stressful.
Victims of COVID-19 must be cared for without being marginalized from society.

The percentages of the responses are given below in pie chart.

Behavioral Parameters

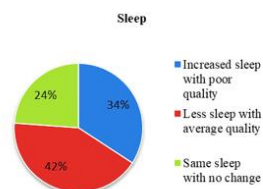


Figure 2: Summary of sleep

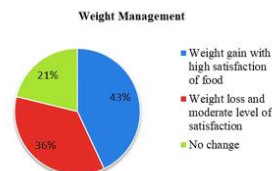


Figure 6: Summary of weight management



Figure 3: Summary of physical activity

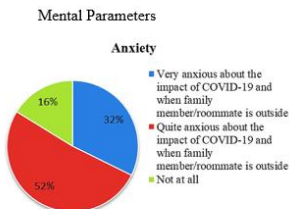


Figure 7: Summary of anxiety

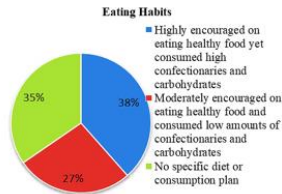


Figure 4: Summary of eating habits

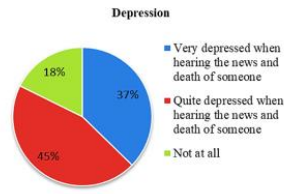


Figure 8: Summary of depression

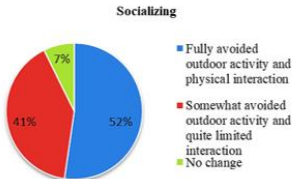


Figure 5: Summary of socializing



Figure 9: Summary of threat perception

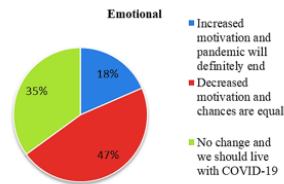


Figure 10: Summary of Emotional

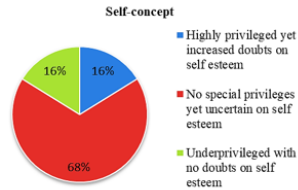


Figure 11: Summary of self-concept

## DISCUSSION

In the behavioural parameter of sleep, 42% of the participants had less sleep with average quality and 34% had increased sleep with poor quality. The results were similar to a study done in Sri Lanka during the COVID-19 pandemic where 49.4% reported an increase in sleep duration but with no change in sleep quality (43.5%) (Sooriyaarachchi et al., 2021). The quantity (duration) and quality of sleep have been associated with CHD (Buysse, 2014). Disturbed sleep leads to increased autonomic sympathetic activity;

ranging from mood swings to psychotic episodes and hallucinations (Waters et al., 2018).

48% of the participants have decreased exercise and increased screen time. A

sympathoadrenal activation results in a stress response that includes transient hemodynamic, vasoconstrictive, and prothrombotic activities which affect the nocturnal sympathetic activity regulation suggesting an association between sleep disruption, CVD, and mental disorders; sleep disruption may also have a direct impact on functionality, including cognition and mood, by altering stress hormones (Medic, Wille and Hemels, 2017). Chronic period without sleep is linked to cognitive problems resulting in psychiatric symptoms

similar pattern was observed in a research done in Sri Lanka where 52.4% of people reported their daily exercise decreased, 63.5% increased sitting time and 80% increased screen time (Sooriyaarachchi et al., 2021). Similar results were also

obtained in another study conducted among college students aged 20-36 years, where physical activity decreased by 68% as sitting time increased by 52% (Sañudo, Fennell and Oliver, 2020). In research, intense physical activity and quicker walking pace were negatively linked with incidence of T2D, while sedentary habits were associated positively (Joseph et al., 2016). Sedentary lifestyle and less physical activity can be risk factors leading to  $\beta$ -cell dysfunction in pancreas and/or insulin resistance in the liver, adipose tissue or skeletal muscle resulting in excess glucose (Zheng, Ley and Hu, 2017).

Physical activity has been shown to promote cerebral perfusion, neurogenesis and synaptogenesis, decrease neuronal loss, and preserve brain volume in areas vulnerable to Alzheimer's disease, as well as positively influence pathological processes such as  $\beta$ -amyloid accumulation and tau phosphorylation (Stephen et al., 2017). Only 15% do exercise daily and have reduced screen time. Strenuous exercise can lead to OTS and ER. OTS can be caused due to systemic inflammation or due to its accompanying consequences on the central nervous system, such as depressed mood, central fatigue and neurohormonal alterations (Kreher and Schwartz, 2012). In ER, myoglobin leaks from the myocyte and rises to levels surpassing the plasma protein-binding capacity resulting in precipitation of myoglobin in the glomerular filtrate, obstructing the renal tubules and leading to acute renal failure (Scalco et al., 2016). Regular aerobic exercise improves colon motility and has beneficial effect on the gut by lowering transient stool time and pathogen contact time with the gastrointestinal mucosa layer; exercise also decreases prostaglandin production and inflammation, as well as protect intestinal integrity preventing the risk of colon cancer and other inflammatory diseases (Jurdana, 2021).

37% had never exercised and had no change in screen time. Participants in sedentary employment or who worked for 10 or more years in a sedentary job had a 2 times greater risk of distal colon cancer and about 1.5 times risk of rectal cancer; but the risk of proximal colon cancer was not linked to sedentary work, though it was considerably lower among those in professions that required heavy physical activity (Boyle et al., 2011). Insulin resistance has been associated with the development of cancer in some ways; hyperglycaemia may promote carcinogenesis by creating a favourable environment for tumour development as neoplastic cells require glucose for proliferation; elevated insulin levels increase the bioavailable insulin-like growth factor-I which is related to cell differentiation, proliferation, and apoptosis (Lynch, 2010). Increased screen time can cause eye problems such as eye strain, redness and blurred/double vision which are all categorized together as "Computer Vision Syndrome" (Sitaula and Khatri, 2018). In a study conducted among engineering and medical school students in Chennai, males were more likely to have symptoms such as redness, burning, impaired vision, and dry eyes; females had a substantially greater chance of getting headaches, neck and shoulder discomfort (Logaraj, Madhupriya and Hegde, 2014).

35% of the participants had no specific diet or consumption plan and 27% consumed low amounts of confectionaries and carbohydrates yet were moderately encouraged on eating healthy food. A majority (38%) of them were consuming increased amounts of confectionaries and carbohydrates though they were encouraged on eating healthy food. Our results were similar to the survey conducted during UK lockdown where there was an increase in the general food intake (48%) and in that 22-26% of individuals reported an increase in high

energy-dense sweet and savoury meals (Buckland et al., 2021). In a study in Denmark, consumption of sweets, chocolate and bread were more likely to increase in families with children than in households with >2 adults and increased consumption of fruits and vegetables when compared to single-person households (Janssen et al., 2021). A dose-response correlation was found between consumption of sugar-sweetened beverages (SSB) and fatty liver disease; in comparison to non-SSB drinkers, daily SSB consumers had a 55% higher risk of fatty liver disease (Ma et al., 2015). NAFLD is the most common chronic liver disease in Sri Lanka with a prevalence rate of 32.6% and is most likely related to higher living standards, with the growing prevalence of sedentary lifestyle and unhealthy eating habits (Dassanayake, 2018). In a study, the most significant decrease in fatty liver, with the prevalence of NAFLD declined from 62% to 31.5% in the green Mediterranean diet; 47.9% in the standard Mediterranean diet and 54.8% in the group which followed healthy dietary guidelines, hence the most preferred diet is the green Mediterranean diet which included diet rich in mankai, walnuts, enhanced plasma polyphenols and serum folate with red and processed meat being restricted (Meir et al., 2021).

In a 12-year follow-up research, it was found that increased afternoon-snack GL was linked with an elevated risk of dementia and Alzheimer's Disease in APOE-ε4 carriers which was independent of calorie consumption, Mediterranean-style diet, and physical activity; there are three possible explanations for the interaction between APOEε4 carriers and afternoon-snack GL on dementia risk; firstly, afternoon snacks (sweets, biscuits and soda) are most likely to have high GL because they are higher in refined carbohydrates; they are digested more quickly due to their reduced-fat and fibre content, as a result, post-prandial

glycaemia rises quickly and insulin reaches its peak concentration, this recurrent chronically high and transitory insulin peaks may exacerbate insulin resistance by oxidative damage and inflammation; secondly, insulin resistance is more common in APOEε4 carriers because they are less resistant to oxidative stress as they have poorer antioxidant activity and finally, in APOEε4 carriers, the link between insulin resistance and risk of dementia is greater (Gentreau et al., 2020).

In the behavioural parameter of socializing, 52% of the participants reported to have fully avoided outdoor activity and physical interaction, and 41% reported that they have somewhat avoided outdoor activity and had quite limited interaction. In a Finnish study done among men for a follow-up of nearly 20 years, it was found that loneliness and social isolation were linked to overall cancer incidence (Kraav et al., 2021). In another population-based study with a 23-year follow-up, social isolation and high neighbourhood poverty were associated with increased risk of cancer mortality (Marcus et al., 2017).

36% reported weight loss and moderate satisfaction of food. Most participants (43%) reported high satisfaction of food with weight gain. Similar weight gain has been observed in other studies too (Bakaloudi et al., 2021; Jia et al., 2021; Mulugeta, Desalegn and Solomon, 2021; Zachary et al., 2020). In research, strong association was present between obesity and gall stone diseases (Liu et al., 2018; Stender, Nordestgaard and Hansen, 2013; Su et al., 2019). Contrastingly, in a study among undergraduate students, anaemia was prevalent in underweight individuals (Khan et al., 2018). Hence, it is important to have a body weight according to the body mass index. 52% of respondents reported being quite anxious and 32% as very anxious. 45% reported being quite depressed and 37% as very depressed.

Results were comparable to previous studies done among university students, with increased anxiety and depression (Basheti, Mhaidat and Mhaidat, 2021; Woon et al., 2021). Recent research has confirmed that IBS symptoms are frequently aggravated by stressful situations and that psychiatric therapy improves gastrointestinal manifestations (Popa and Dumitrascu, 2015). In a population-based study, 47.6% of those who were at high risk for insomnia also experienced anxiety or depression (Oh et al., 2019); similar results in another study too (Li et al., 2016).

The majority of the respondents (68%) reported no special privileges at all and were uncertain about self-esteem. 18% were optimistic hoping that the pandemic will end and reported increased motivation to study, 35% reported, we have to live with it but majority (47%) reported decreased motivation and were uncertain about the pandemic. Pessimism appeared to be a definite risk factor for CHD with hypertension but optimism was not a protective factor (Pänkäläinen, Kerola and Hintikka, 2015). 17% reported they were very likely to contract COVID-19 and fear going outside whereas 62% reported minimal chances and were quite scared to visit. Similar results were obtained in other studies (Mertens et al., 2020; Nielsen et al., 2020).

## **CONCLUSION**

The overall results of the study revealed in behavioural parameters; sleep, socializing, physical activity has decreased while screen time, weight gain, eating confectionaries and carbohydrates has increased. In mental parameters, anxiety, depression, threat perception has increased while emotional and self-concept has decreased. As stated above, there are many changes in behavioural and mental parameters due to COVID-19 among the students in tertiary education

system aged 25-30 which can be a risk factor to many chronic illnesses, therefore proper awareness initiatives should be provided to take precautions and make necessary lifestyle changes to live a happy and healthy life.

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