



Original Research

COVID-19 pandemic: Is teenagers' health in crisis? An investigation into the effects of COVID-19 on self-reported mental and physical health of teenagers in secondary education[☆]



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A B S T R A C T

Objectives: To evaluate the effects of the COVID-19 lockdown on the self-reported perception of physical and mental health, in a cohort of teenagers. To assess the extent to which these effects are perceived as detrimental.

Non-directional Hypothesis - the perception of physical and mental health will change over the duration of the eight weeks, due to the effects of the lockdown, as a result of COVID-19.

Design: This was a prospective longitudinal study evaluating the effects of the COVID-19 lockdown in the UK over the eight week period, against the political timeline during which the study was conducted (April 08, 2020–June 04, 2020).

Setting: Participants were all in secondary education, ranging from years 10–13 (ages 15–18).

Participants: 55 volunteers have taken part in the study, the group of participants was mixed-sex and of different ethnic groups. Participants were chosen via an opportunity sampling method. All participants stem from a middle to high socioeconomic background. The target demographic of the study was teenagers in secondary education, so participants have been selected from a volunteer sample that is representative of this population.

Main outcome measures: Physical health and Mental health.

Results: Data obtained was synchronised with the political timeline over the eight week period, in order to provide specific interpretations for the findings of the study. Measures of physical health: Sleep with a median length of 8 h in comparison to seven before lockdown (SD between 1.236 and 1.835); 70.00% of participants experienced a decline in their physical health; Productivity amongst participants slightly decreased (76.70%–62.90%). The measures of mental health: Length of screen time, with a median length of 6 h in comparison to four before lockdown (SD between 1.48 and 3.3), however, it remained stagnant over the study period and participants did not experience a further increase; The number of hours spent on social media also increased, with an increasing number of participants spending over 4 h on social media; Conflicts increased in their family environment (from 25.60% to 37.10% of participants reporting more conflicts). During virtual school, conflict was at its lowest point (18.40%) and harmony in the family environment was at its highest peak (65.80%). 51.00% of participants relayed a decline in their mental health. A statistically significant correlation was found between exercise and creativity, both of which decreased over the study period ($r_s = 0.42$ is bigger than the critical value = 0.22 when $p = 0.05$).

Conclusions: Despite certain positive effects, the overall impact of lockdown during the COVID-19 pandemic has been negative, regarding both physical and mental health, for this cohort of young people.

1. Introduction

On December 31, 2019, the World Health Organization (WHO) was informed of a cluster of cases of pneumonia, of unknown cause, detected in Wuhan City, Hubei Province, China. On January 12, 2020 it was announced that a novel coronavirus had been identified in samples obtained from cases, and that initial analysis of virus genetic sequences suggested that this was the cause of the outbreak. This virus is referred to as SARS-CoV-2, and the associated disease as COVID-19 [1].

Consequently, the virus has resulted in a nationwide lockdown. The term 'lockdown' refers to a situation in which people are not allowed to enter or leave a building, or area because of an emergency [2]. The first national lockdown was introduced on March 23, 2020 in the United Kingdom, along with disease containment measures such as social distancing, home quarantine and school closures [3].

With the spread of the virus worldwide, studies began investigating the effects of COVID-19 on the mental and physical health of both adult and young adult populations around the world. The WHO defines health

[☆] All quantitative data that supports the findings of this study is available in the supplementary material of this article in the form of data tables. All free text data not included in the main manuscript, is available from the corresponding author upon reasonable request.

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<https://doi.org/10.1016/j.puhip.2021.100099>

Received 9 November 2020; Received in revised form 11 February 2021; Accepted 25 February 2021

Available online 16 March 2021

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as a state of complete physical, mental and social wellbeing, and not merely the absence of disease or infirmity [6]. Physical health is defined as the condition of the body, taking into consideration everything from the absence of disease to fitness level [5]. Physical health constitutes the following: physical activity; nutrition and diet; drugs and alcohol consumption; and periods of rest and sleep undertaken [4]. Mental health is a state of well-being in which the individual: realises his or her own abilities; can cope with the normal stresses of life; can work productively; and is able to make a contribution to his or her community [7]. and will consider these various factors: ability to realise and fulfil one's potential, coping with the stresses of life, working productively and creatively, connecting with others in the outside world and finally quality and duration of sleep [8].

As the spread of the virus originated in China, studies were conducted and published investigating the effects of COVID-19 on the mental health of both the adult population [9], and college students in China and Italy [10,11]. Early studies in Chinese college students showed the deleterious effects of the pandemic on young adults' mental and physical health. Specifically, Zhang et al. found that the COVID-19 death count showed a direct negative impact on general sleep quality and an indirect impact on general negative emotions, stress, and anxiety with sleep quality as a mediator [10]. This corresponds to the findings of Talevi et al. in an Italian sample of the general population and health care workers. Talevi et al. found that people experienced considerable psychological distress during the initial stage of the CoViD-19 outbreak in terms of anxiety, depression and post-traumatic symptoms [11] In relation to the WHO definition of health, Zhang et al. addressed both physical and mental wellbeing assessing physical activity and negative emotions. Talevi et al. addressed the aspect of mental wellbeing within the WHO's definition of health assessing psychological problems and the necessary psychological first aid that should follow. Given the varied national responses to the pandemic, it is important to explore the impact of the pandemic on young adults in the United Kingdom.

The objective of this study was to analyse the impacts of the COVID-19 lockdown on the self-reported perception of physical and mental health (as defined by WHO according to the definitions stated above), in a sample of teenagers and to assess the extent to which these effects are perceived as detrimental. Adolescents were chosen as the research group because this is a formative time developmentally, and as a group they are likely to be significantly impacted by the lockdown. The authors hypothesised, that physical and mental health, will change over the duration of the eight weeks, due to the effects of the lockdown, as a result of COVID-19. The aim of this study was to deduce conclusions regarding how COVID-19 impacts physical and mental health of teenagers in secondary education.

2. Methodology

The selection of aspects of health being assessed, were based on the use of the WHO International Classification for Functioning Disability and Health. The domains of health are: Body Functions & Structure; and Activity & Participation. As the authors were part of the target demographic, questions were chosen that could assess aspects of mental and physical health of particular pertinence to the demographic. In addition to aspects of health that are generalisable to the population of the UK such as sleep and exercise, aspects specific to the teenage demographic such as screen time and social media were also examined. Three different questionnaires were written to suit different purposes: a pre-study questionnaire, an ongoing questionnaire and a post-study questionnaire (see [appendices](#)). The pre-study questionnaire would provide a set of results to compare with the results obtained during lockdown. The final two questions were chosen as the themes discussed here (mass hysteria and the effect of examination cancellations on education) were felt to be particularly pertinent to the target demographic and would not be suitable to be asked every week. The ongoing questionnaire would provide responses that were analysed for changes over

the course of the eight weeks, to identify any patterns in specific aspects of physical and mental health. The responses were also cross-referenced with the political timeline, to provide further explanations for the results. The post-study acted as a concluding questionnaire, asking participants to recall the last eight weeks, and make a judgement on the general perception of change in behaviour, over the course of the study.

The study was conducted over eight weeks during which national lockdown in England was in place. This period of time was underpinned by a political timeline. The study started three weeks following the implementation of a nationwide lockdown on March 23, 2020. At the beginning of the third week, 'virtual school' commenced following the Easter holidays. During week seven, all students had half-term holidays before resuming school again, for week eight of the study. During week eight, lockdown restrictions were eased to allow groups up to six people to meet outside. The results obtained over the eight week period were matched in accordance with this political timeline, in order to provide specific explanations for some of the findings that had arisen from 'virtual school' or school holidays.

Primary data (questionnaires) had been analysed weekly, in the form of a longitudinal self-report study, using an opportunity sampling method. The researchers selected a sample of students within the target demographic who were attending secondary schools in the Midlands at the time. The participants were contacted via email and asked if they would be interested in participating in research with the aims of investigating changes in physical and mental health over the lockdown period. Participants were selected from the volunteer sample to be representative of students aged 13–18 years, of middle to high socioeconomic status. The data was collected online, anonymised and stored on an encrypted memory stick.

55 volunteers have taken part in the study, the group of participants was mixed-sex and of different ethnic groups. Participants were chosen via an opportunity sampling method. All participants stem from a middle to high socioeconomic background. The target demographic of the study was teenagers in secondary education, so participants have been selected from a volunteer sample that is representative of this population.

This study received ethics approval from the senior leadership board of the institution. Before taking part in the study, all participants signed consent that informed them of all aspects of their participation in the study and their rights surrounding this participation. Participants were informed that the study did not involve deception and results would remain confidential and anonymised.

A pre-study questionnaire was sent to participants at the beginning of the study, consisting of six questions, providing a standard set of responses. This standard set of responses offered comparison for future weeks and the final week of the study, in order to analyse any differences in behaviour over the course of the study. In the pre-study questionnaire, one question focused on Body Functions & Structure, and five questions focused on Activity & Participation. Three questions surrounded physical health (regarding exercise and sleep), whilst three were indicative of mental health (screentime, social media and effects on education). One question in the pre-study questionnaire surrounding education required the use of free text, for participants to reflect on their own specific aspects of health before lockdown began.

There were a total of thirteen questions for each of the ongoing questionnaires that were completed on a weekly basis; they were quick and easy to complete. The questionnaire consisted of thirteen questions: six of which were concerning mental health (sleep, exercise, appetite, caffeine, alcohol, productivity, headaches, indigestion and migraines); and seven regarding physical health (screentime, social media, creativity, socialising, conflict and harmony (living together peacefully rather than arguing [12])). In the ongoing questionnaire, five questions focused on Body Functions & Structure (such as, 'For how many hours are you going outside everyday for exercise?' with the options being '0-1, 1-2 and 2+'), and eight questions focused on Activity & Participation.

At the end of the study period, participants were sent a post-study questionnaire containing eight questions: five of which were regarding

physical health (general improvement of physical health, healthiness of foods, learning of a new skill, teaching affecting productivity, sleep schedule, and lifestyle change); with the remaining three queries surrounding mental health (including general improvement of mental health and level of interaction). Three questions about lifestyle change, the general improvement of physical health, and the general improvement of mental health, were written in free text. For example, ‘Has the lockdown caused a positive or negative change in your lifestyle? In what way?’ In the post-study questionnaire, four questions focused on Body Functions & Structure, and four questions focused on Activity & Participation. This questionnaire differed to prior questionnaires on the grounds that it focussed on the overall perceptions that health participants experienced when reflecting on the last eight weeks in their entirety.

The forms of statistical analysis used in this study were the Sign Test and the Spearman Rank Test. The Sign Test was used in order to detect if there was a statistically significant difference in duration of sleep between the week before lockdown and the first week of lockdown. The Spearman Rank Test was used to assess if there was a statistically significant association between creativity levels and exercise. The median values for sleep and screen time were used, in order to graph the results allowing for weekly comparisons between findings before and during lockdown. The median was preferred as opposed to mean values, in order to ensure that the results were not influenced by extreme values. Two researchers analysed free text data through a form of thematic analysis. The researchers used a deductive approach which involved looking at the data with preconceived themes that the researchers had expected to identify based on the factors chosen to investigate. The researchers also used a latent approach which involved reading into the underlying assumptions of the data. From this approach the researchers then carried out a thematic analysis developed by Braun and Clarke.

Content analysis, in particular, was used by assigning ‘typical’ language to predetermined behavioural categories, which could then be counted to find the overall frequency of each behaviour. The free text results were analysed individually in order to establish inter-observer reliability. Free text results were reached after comparison between each researcher’s analysis, such as when concluding what the most popular reasons were behind each change in behaviour.

3. Results

55 participants were enrolled in the study (44 females and 11 males with an age range of 15–18,

and a median age of 17) and the questionnaire return rate for all the participants throughout the study period (pre-study, ongoing questionnaire and post-study questionnaires) was 100.00% (see Table 1).

Physical Health (for the numerical data of these factors see Tables 2–5):

3.1. Sleep

The results showed an increase in the amount of sleep experienced by participants, which decreased slightly following the start of the new school term. However, this still marks an increase in comparison to before lockdown (see Fig. 1 - distribution of hours of sleep).

Table 1

This table shows the distribution of participants by gender and age.

Age	Number of Males	Number of Females
15	1	0
16	3	16
17	6	28
18	1	0

3.2. Sign Test for increase in sleep

There is a statistically significant correlation in sleep over the eight week period, shown by the Sign Test. The calculated value of $S = 1$, is smaller than the critical value of 6.71, when $p = 0.05$. Therefore the null hypothesis (that there would be no change in the amount of sleep during lockdown) is rejected.

3.3. Exercise

The results also showed a decreasing trend in the amount of exercise over the 8 weeks (the percentage of participants who conducted exercise each week can be seen in Fig. 2 and Fig. 3 - distribution of exercise). However, for those who conducted exercise, the length of exercise remained constant, with the majority of participants conducting 0–1 h of exercise per day.

3.4. Overall decline in physical health

70.00% of participants reported a decline in their physical health.

3.5. Free text results as to why physical health had declined

A decline in physical health was a result of the decrease in the levels of exercise as well as the consumption of unhealthy foods (see Fig. 4 for link to appetite).

Free text results as to why physical health had improved:

An improvement in physical health was a result of the increased sleep and the lack of sleep deprivation symptoms (such as exhaustion).

Mental Health (for the numerical data of these factors see Tables 6–9):

3.6. Screen time

The length of screen time (see Fig. 5 and Fig. 6 - distribution of screen time) and subsequently the number of hours spent on social media (see Fig. 8 - distribution of hours spent on social media) increased in comparison to before lockdown. However, this remained stagnant over the study period and participants did not experience a further increase.

3.7. Social media use

The length of time spent on social media did not substantially change over the eight week study period (see Fig. 7 - distribution of hours spent on social media) however, an increase in the time spent on social media between the first week of lockdown and the week prior to lockdown was noted.

3.8. Creativity

Participants also experienced a general decrease of creativity with one peak at week 4 which could not be analysed as showing significance (the percentage of participants who did something creative each week can be seen in Fig. 9 - the distribution of creative acts).

3.9. Conflict and harmony

Participants experienced an increase in conflicts in their family environment during periods where participants were not attending school with a decrease in harmony during this time. However, during periods where participants were occupied with ‘virtual school’, conflicts decreased (to the lowest peak of 18.40%), and levels of harmony consequently increased (at an apex of 65.80%). (The percentage of participants who experienced more conflicts, more harmony, more of both, and more of neither, each week can be seen in Fig. 11 - the distribution of harmony and conflicts within families.)

Table 2

This table shows the results for the Pre-study questionnaire and weeks 1 and 2 for Physical Health (sleep, exercise, amount of exercise, appetite, headaches, indigestions and migraines, caffeine intake and alcohol intake).

Factor	Week								
	Pre-Study	1		2					
Sleep (hours)		7±1.54		9±1.41				9±1.24	
Exercise		n/a		55.80%				84.40%	
Amount of Exercise (hours)		n/a		Percentage of Participants				Percentage of Participants	
		0-1	1-2	2+	n/a	0-1	1-2	2+	n/a
		67.30%	29.00%	3.70%		73.70%	24.30%	2%	
Appetite		n/a		Percentage of Participants				Percentage of Participants	
		Increased	Decreased	n/a	Increased	Decreased	n/a		
		53.50%	46.50%		44.40%	55.60%			
Headaches, Indigestion and Migraines		n/a		Percentage of Participants				Percentage of Participants	
		Experienced no more	Experienced an Increase	Unsure	n/a	Experienced no more	Experienced an Increase	Unsure	n/a
		55.80%	32.60%	11.60%		68.90%	24.40%	6.70%	
Caffeine Intake		n/a		Percentage of Participants				Percentage of Participants	
		Increased	Decreased	Stayed the Same	n/a	Increased	Decreased	Stayed the Same	n/a
		38.10%	9.50%	52.40%		33.30%	9.50%	57.10%	
Alcohol Intake		n/a		Percentage of Participants				Percentage of Participants	
		Increased	Decreased	Stayed the Same	n/a	Increased	Decreased	Stayed the Same	n/a
		28.60%	28.50%	42.90%		33.30%	50.00%	16.70%	

Table 3

This table shows the results for the weeks 3 and 4 for Physical Health (sleep, exercise, amount of exercise, appetite, headaches, indigestions and migraines, caffeine intake and alcohol intake).

Factor	Week								
	3	4		4					
Sleep (hours)		8±1.84		Median±SD				8±1.59	
Exercise		81.00%		Percentage of Participants				64.90%	
Amount of Exercise (hours)		n/a		Percentage of Participants				Percentage of Participants	
		0-1	1-2	2+	n/a	0-1	1-2	2+	n/a
		70.60%	29.40%	0%		70.80%	25%	4.20%	
Appetite		n/a		Percentage of Participants				Percentage of Participants	
		Increased	Decreased	n/a	Increased	Decreased	n/a		
		46.10%	52.90%		48.60%	51.40%			
Headaches, Indigestion and Migraines		n/a		Percentage of Participants				Percentage of Participants	
		Experienced no more	Experienced an Increase	Unsure	n/a	Experienced no more	Experienced an Increase	Unsure	n/a
		59.50%	38.10%	2.40%		70.30%	24.30%	5.40%	
Caffeine Intake		n/a		Percentage of Participants				Percentage of Participants	
		Increased	Decreased	Stayed the Same	n/a	Increased	Decreased	Stayed the Same	n/a
		36.40%	27.30%	36.40%		47.40%	15.80%	36.80%	
Alcohol Intake		n/a		Percentage of Participants				Percentage of Participants	
		Increased	Decreased	Stayed the Same	n/a	Increased	Decreased	Stayed the Same	n/a
		40.00%	20.00%	40.00%		22.20%	22.20%	55.60%	

3.10. Spearman rank for the correlation between exercise and creativity

A positive correlation that was statistically significant was also found between exercise and creativity, both of which decreased over the study period ($r_s = 0.42$ is bigger than the critical value = 0.22 when $p = 0.05$).

3.11. Overall decline in mental health

51.00% of participants reported a decline in their mental health.

3.12. Free text results as to why mental health had declined

A decline in mental health was a result of the lack of social interaction

(see Fig. 10), the decreased productivity (see Fig. 12) and motivation (as a result of the changes in their sleep schedule), and the increased conflicts within families.

3.13. Free text results as to why mental health had improved

An improvement in mental health was a result of the increased leisure time.

Headaches, Indigestion and Migraines and Caffeine consumption and Alcohol consumption did not show a significant trend and the results fluctuated every week and cannot be said to have been affected by the COVID-19 lockdown.

The Effect of Social Media did not change significantly throughout the

Table 4

This table shows the results for the weeks 5 and 6 for Physical Health (sleep, exercise, amount of exercise, appetite, headaches, indigestions and migraines, caffeine intake and alcohol intake).

Factor	Week							
	5				6			
Sleep (hours)	8±1.5				Median±SD			
Exercise	66.70%				Percentage of Participants			
Amount of Exercise (hours)	0–1	1–2	2+	n/a	0–1	1–2	2+	n/a
Appetite	70.80%	29.20%	0%	a	72.65%	22.90%	4.45%	a
	Percentage of Participants				Percentage of Participants			
Headaches, Indigestion and Migraines	Increased	Decreased	Unsure	n/a	Increased	Decreased	Unsure	n/a
	52.80%	47.20%	2.80%	a	42.10%	57.90%	5.30%	a
Caffeine Intake	Experienced no more	Experienced an Increase	Stayed the Same	n/a	Experienced no more	Experienced an Increase	Stayed the Same	n/a
	69.40%	27.80%	55.60%	a	65.80%	28.90%	42.10%	a
Alcohol Intake	Increased	Decreased	Stayed the Same	n/a	Increased	Decreased	Stayed the Same	n/a
	27.80%	16.70%	51.70%	a	31.60%	26.30%	42.10%	a

Table 5

This table shows the results for the weeks 7 and 8 for Physical Health (sleep, exercise, amount of exercise, appetite, headaches, indigestions and migraines, caffeine intake and alcohol intake).

Factor	Week							
	7				8			
Sleep (hours)	8±1.32				Median±SD			
Exercise	65.70%				Percentage of Participants			
Amount of Exercise (hours)	0–1	1–2	2+	n/a	0–1	1–2	2+	n/a
Appetite	69.55%	26.10%	4.35%	a	59.20%	37%	3.80%	a
	Percentage of Participants				Percentage of Participants			
Headaches, Indigestion and Migraines	Increased	Decreased	Unsure	n/a	Increased	Decreased	Unsure	n/a
	54.30%	45.70%	20%	a	57.10%	42.90%	8.60%	a
Caffeine Intake	Experienced no more	Experienced an Increase	Stayed the Same	n/a	Experienced no more	Experienced an Increase	Stayed the Same	n/a
	60%	20%	42.10%	a	57.10%	34.30%	31.60%	a
Alcohol Intake	Increased	Decreased	Stayed the Same	n/a	Increased	Decreased	Stayed the Same	n/a
	36.80%	21.10%	62.50%	a	36.80%	27.80%	45.60%	a

study period and therefore cannot be said to have been affected by the COVID-19 lockdown.

4. Discussion

This study was conducted by a team of students in secondary education, in order to investigate the impact the COVID-19 lockdown would have on the demographic. This was prompted by the research that was conducted in both China and Italy [10,11], which clearly showed the impact of the containment measures on mental health. Therefore, in order to investigate this impact, this prospective study was designed to show changes in aspects of physical and mental health over eight weeks.

With reference to sleep, the authors found that participants were sleeping for longer during lockdown, with a median length of 8 h in

comparison to seven before lockdown. There is a statistically significant correlation in sleep over the eight week period. Participants could wake up later in the day, which might have had a positive effect on the participant’s health, due to the lack of scheduled activities such as school, participants were able to sleep in accordance with their natural adolescent circadian rhythm. Before lockdown, participants were likely to experience 2 h of sleep deprivation per day [13]. However, the ability to follow the later rise of melatonin levels present in adolescence, participants were able to sleep for longer. These results contrast with the adult population, who during lockdown have experienced less restful and decreased sleep, as shown by a study carried out at King’s College London exploring the changes of sleep under lockdown in participants aged 16–75 [14]. A positive effect on participant’s health can be seen due to the alignment with the adolescent circadian rhythm, thereby allowing for

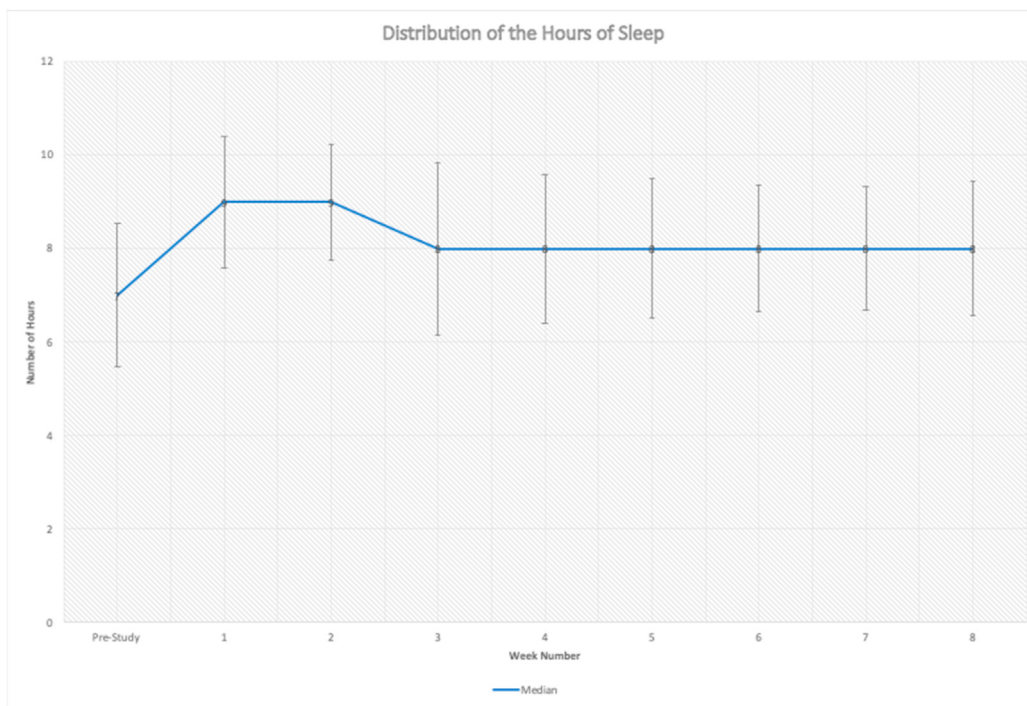


Fig. 1. The duration of sleep of participants varied across the eight weeks of the study. This is shown by using the median±standard deviation.

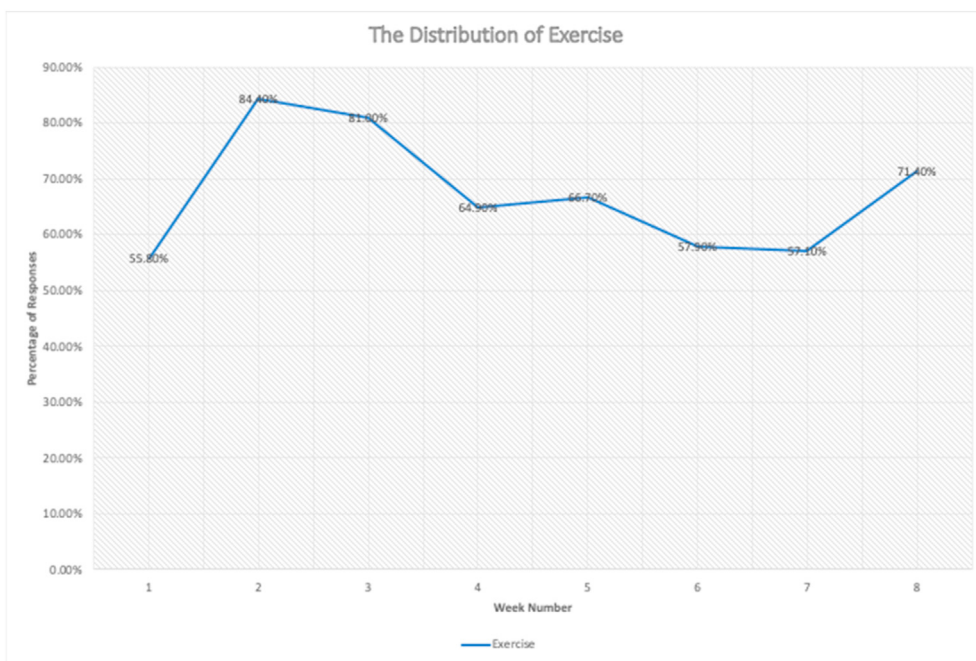


Fig. 2. Exercise patterns.

increased sleep. However, despite being able to sleep longer, when asked in the post-study questionnaire whether lockdown had had a positive or negative effect on their lifestyle, 59.00% of participants reported a negative change, quoting the change in their sleep schedule as a major contributing factor to that change. The benefits of a routine consisting of a continuous lack of sleep might therefore potentially outweigh the positives of increased sleep, as the participants reported decreased productivity and feeling less motivated due to the change in sleep schedule.

The authors found that a decrease in exercise leads to a decrease in creativity. Although the decline in creativity is also affected by factors,

such as the commencement of school and the resulting increase in workload, there still remains a statistically significant correlation between creativity and exercise. A study by Stanford University showed the positive effect of walking on creative thinking, with an increase in creative output of around 60.00% following walking [15]. The observed decrease in exercise of participants could be correlated with a decrease in physical wellbeing with the decrease in creativity being linked to a decrease in mental wellbeing, due to links between creativity and positive psychological functioning [16]. This link can be further seen in the Lyubomirsky and Layous Positive Activity Model [17], outlining that a

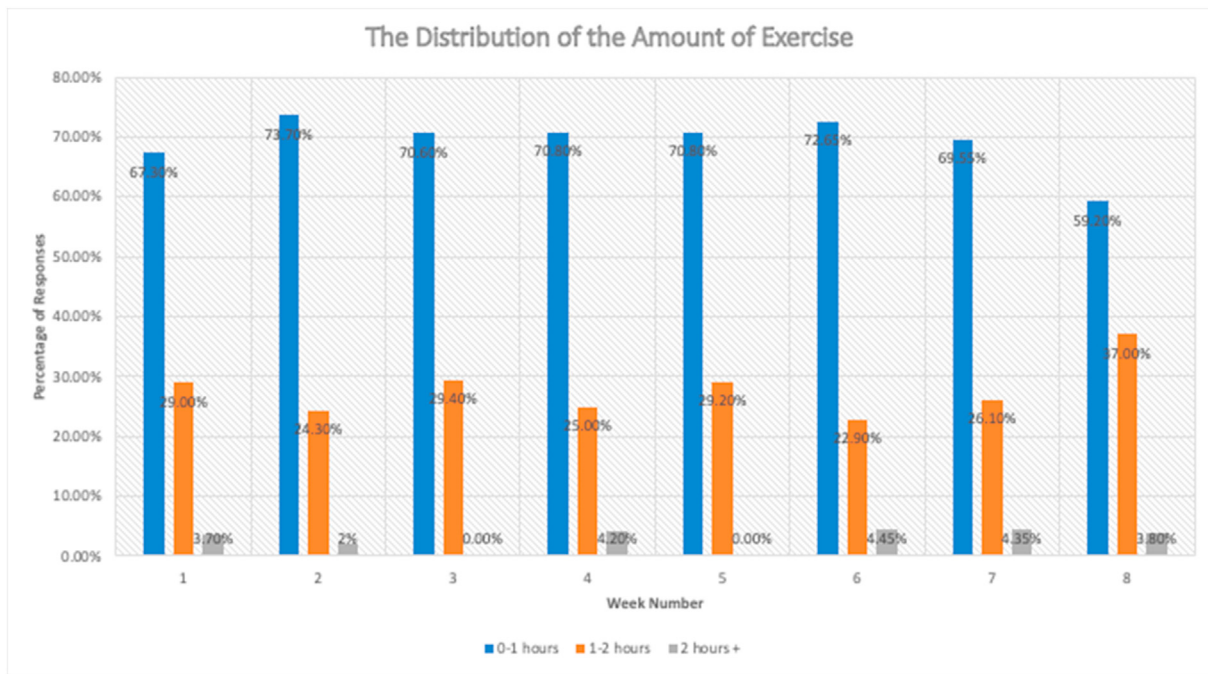


Fig. 3. Amount of exercise varied across the eight weeks. This is shown by the percentage of people who exercised either between 0-1 h; 1-2 h; or over 2 h every day.

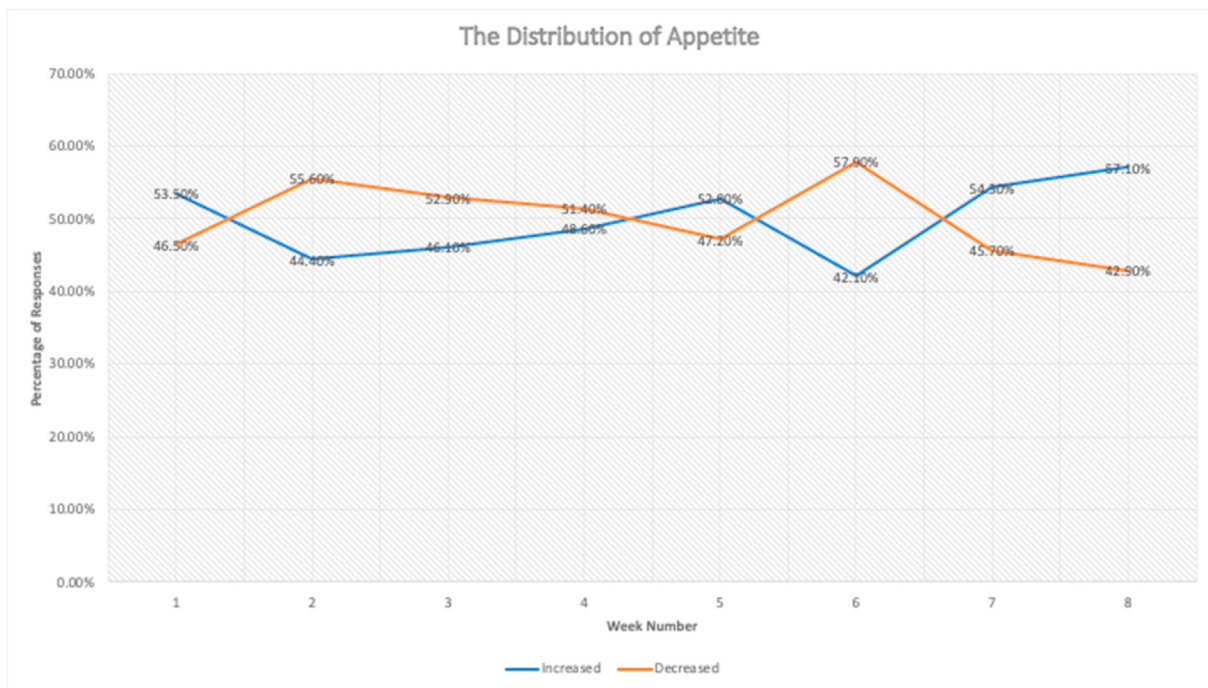


Fig. 4. Appetite variation.

decrease in creativity would lead to a decrease in mental wellbeing. With reference to Harmony and Conflict, participants' rates of conflict and harmony were in accord with the political timeline conducted over the eight week period. The levels of conflict were highest (40.00%) during the school holidays, as seen in week two - synonymous with the Easter holidays, whilst harmony was at its lowest during this time (44.40%). This is a result of participants having a greater quantity of leisure time, therefore being able to interact with others, in this case their families, more often. However, the level of harmony was at its highest during the period of 'online schooling', as seen in week six (65.80%),

with lower rates of conflict (18.40%) by consequence, due to participants being engaged with online work, which occupied more of their free time. The decline in physical health relayed by 70.00% of participants is a result of the decrease in the levels of exercise, as well as the consumption of unhealthy foods (54.00% of participants reported eating considerably more unhealthy foods during this period). However, 30.00% of participants who claimed to have an improvement in their physical health, quoted increased sleep and the lack of sleep deprivation symptoms, such as exhaustion, as the main reason. Furthermore, 51.00% of participants relayed a decline in their mental

Table 6

This table shows the results for the Pre-study questionnaire and weeks 1 and 2 for Mental Health (sleep, screen time, time on social media, effect of social media, the ability to socialise, creativity, harmony and conflicts and productivity).

Factor	Week											
	Pre-Study			1				2				
Sleep (hours)	7±1.54			9±1.41				Median±SD				9±1.24
Screen Time (hours)	4±2.14			6±2.78				Median±SD				6±3.28
Screen Time (hours)								Frequency				
Time on Social Media (hours)	0-2	2-4	4+	0-2	2-4	4+	n/a	0-2	2-4	4+	n/a	
	4	29	22	0	26	39		0	15	40		
Effect of Social Media								Frequency				
	0-2	2-4	4+	0-2	2-4	4+	n/a	0-2	2-4	4+	n/a	
	36	13	6	24	20	11		19	23	13		
The Ability to Socialise	n/a			Both Positive and Negative				Percentage of Participants				n/a
				65.10%				Only Positive				25.60%
Creative Acts	n/a			No				Percentage of Participants				n/a
				83.70%				Yes				16.30%
Harmony and Conflicts	n/a			Yes				Percentage of Participants				n/a
				62.80%				No				37.20%
Productivity	n/a			More Harmony				Percentage of Participants				n/a
				51.20%				More Conflicts				25.60%
								More of Both				11.60%
								Neither				11.60%
								More Harmony				44.40%
								More Conflicts				40.00%
								More of Both				4.40%
								Neither				11.10%
	n/a			Increase				Percentage of Participants				n/a
				14.00%				Decrease				76.70%
								No Change				9.30%
								Increase				20.00%
								Decrease				68.90%
								No Change				11.10%

Table 7

This table shows the results for weeks 3 and 4 for Mental Health (sleep, screen time, time on social media, effect of social media, the ability to socialise, creativity, harmony and conflicts and productivity).

Factor	Week											
	3			4								
Sleep (hours)				8±1.84				Median±SD				8±1.59
Screen Time (hours)				7±3.12				Median±SD				6±3
Screen Time (hours)								Frequency				
Time on Social Media (hours)				0-2	2-4	4+	n/a	0-2	2-4	4+	n/a	
				4	14	37		5	14	36		
Effect of Social Media								Frequency				
				0-2	2-4	4+	n/a	0-2	2-4	4+	n/a	
The Ability to Socialise				Both Positive and Negative				Percentage of Participants				n/a
				73.80%				Only Positive				21.40%
Creative Acts				Only Positive				Percentage of Participants				n/a
				16.70%				No				81.10%
Harmony and Conflicts				Yes				Percentage of Participants				n/a
				47.60%				Yes				56.80%
Productivity				No				Percentage of Participants				n/a
				83.30%				Yes				18.90%
				More Harmony				Percentage of Participants				n/a
				52.40%				More Conflicts				24.30%
				More Conflicts				Percentage of Participants				n/a
				21.40%				More of Both				9.50%
				9.50%				Neither				16.70%
								More Harmony				56.70%
								More Conflicts				24.30%
								More of Both				10.90%
								Neither				8.10%
				Increase				Percentage of Participants				n/a
				21.40%				Decrease				66.70%
								No Change				11.90%
								Increase				18.90%
								Decrease				54.10%
								No Change				27.00%

health as a result of the lack of social interaction, the decreased productivity and motivation (as a result of the changes in their sleep schedule) and the increased conflicts within families. The authors found evidence to support that the lack of social interaction with family and friends is a distressing event and significantly contributes towards a decline in mental health supporting the authors' findings [18].49.00% of

participants who reported an improvement in their mental health argued the increase in leisure time to be the main contributing factor.

The authors were also able to draw broader conclusions that are of public health concern. In particular, the decline in both physical and mental health endorsed by over 50.00% of participants in both respects is concerning and warrants further investigation into more long-term

Table 8

This table shows the results for weeks 5 and 6 for Mental Health (sleep, screen time, time on social media, effect of social media, the ability to socialise, creativity, harmony and conflicts and productivity).

Factor	Week							
	5				6			
Sleep (hours)	Median±SD				Median±SD			
	8±1.5				8±1.35			
Screen Time (hours)	Median±SD				Median±SD			
	6±2.95				6±1.48			
Screen Time (hours)	Frequency							
	0-2	2-4	4+	n/a	0-2	2-4	4+	n/a
	4	15	36		5	14	36	
Time on Social Media (hours)	Frequency							
	0-2	2-4	4+	n/a	0-2	2-4	4+	n/a
	19	22	14		23	20	12	
Effect of Social Media	Percentage of Participants							
	Both Positive and Negative	Only Positive	Only Negative	n/a	Both Positive and Negative	Only Positive	Only Negative	n/a
	55.60%	33.30%	11.10%		57.90%	31.60%	10.50%	
The Ability to Socialise	Percentage of Participants							
	No	Yes	n/a		No	Yes	n/a	
	80.60%	19.40%			81.60%	18.40%		
Creative Acts	Percentage of Participants							
	Yes	No	n/a		Yes	No	n/a	
	47.20%	52.80%			42.10%	57.90%		
Harmony and Conflicts	Percentage of Participants							
	More Harmony	More Conflicts	More of Both	Neither	More Harmony	More Conflicts	More of Both	Neither
	50.00%	30.60%	11.10%	8.30%	65.80%	18.40%	7.90%	7.90%
Productivity	Percentage of Participants							
	Increase	Decrease	No Change	n/a	Increase	Decrease	No Change	n/a
	22.20%	61.10%	16.70%		15.80%	63.20%	21.10%	

Table 9

This table shows the results for weeks 7 and 8 for Mental Health (sleep, screen time, time on social media, effect of social media, the ability to socialise, creativity, harmony and conflicts and productivity).

Factor	Week							
	7				8			
Sleep (hours)	Median±SD				Median±SD			
	8±1.32				8±1.44			
Screen Time (hours)	Median±SD				Median±SD			
	6.73±3.3				6.29±2.59			
Screen Time (hours)	Frequency							
	0-2	2-4	4+	n/a	0-2	2-4	4+	n/a
	4	14	37		6	14	35	
Time on Social Media (hours)	Frequency							
	0-2	2-4	4+	n/a	0-2	2-4	4+	n/a
	18	25	12		18	28	9	
Effect of Social Media	Percentage of Participants							
	Both Positive and Negative	Only Positive	Only Negative	n/a	Both Positive and Negative	Only Positive	Only Negative	n/a
	60%	22.90%	17.10%		54.30%	37.10%	8.57%	
The Ability to Socialise	Percentage of Participants							
	No	Yes	n/a		No	Yes	n/a	
	80%	20%			74.30%	25.70%		
Creative Acts	Percentage of Participants							
	Yes	No	n/a		Yes	No	n/a	
	48.60%	51.40%			40.00%	60.00%		
Harmony and Conflicts	Percentage of Participants							
	More Harmony	More Conflicts	More of Both	Neither	More Harmony	More Conflicts	More of Both	Neither
	48.60%	28.60%	17.10%	5.70%	48.60%	37.10%	11.40%	2.90%
Productivity	Percentage of Participants							
	Increase	Decrease	No Change	n/a	Increase	Decrease	No Change	n/a
	11.40%	62.90%	25.70%		8.60%	74.30%	17.10%	

effects that the lockdown could have on the mental and physical health of adolescents as well as retrospective research evaluating disease-containment measures taken to prevent the spread of SARS-CoV-2. The authors also noted that the decline in physical health was reported by a greater number of participants than the decline in mental health which shows a need for more education surrounding the importance and

necessity of exercise and other contributing factors to physical health such as sufficient sleep during lockdown as means for maintaining physical health amongst adolescents. Further prospective studies could also be carried out during the continuing lockdowns in order to evaluate whether effects on mental and physical health are exacerbated or reduced.

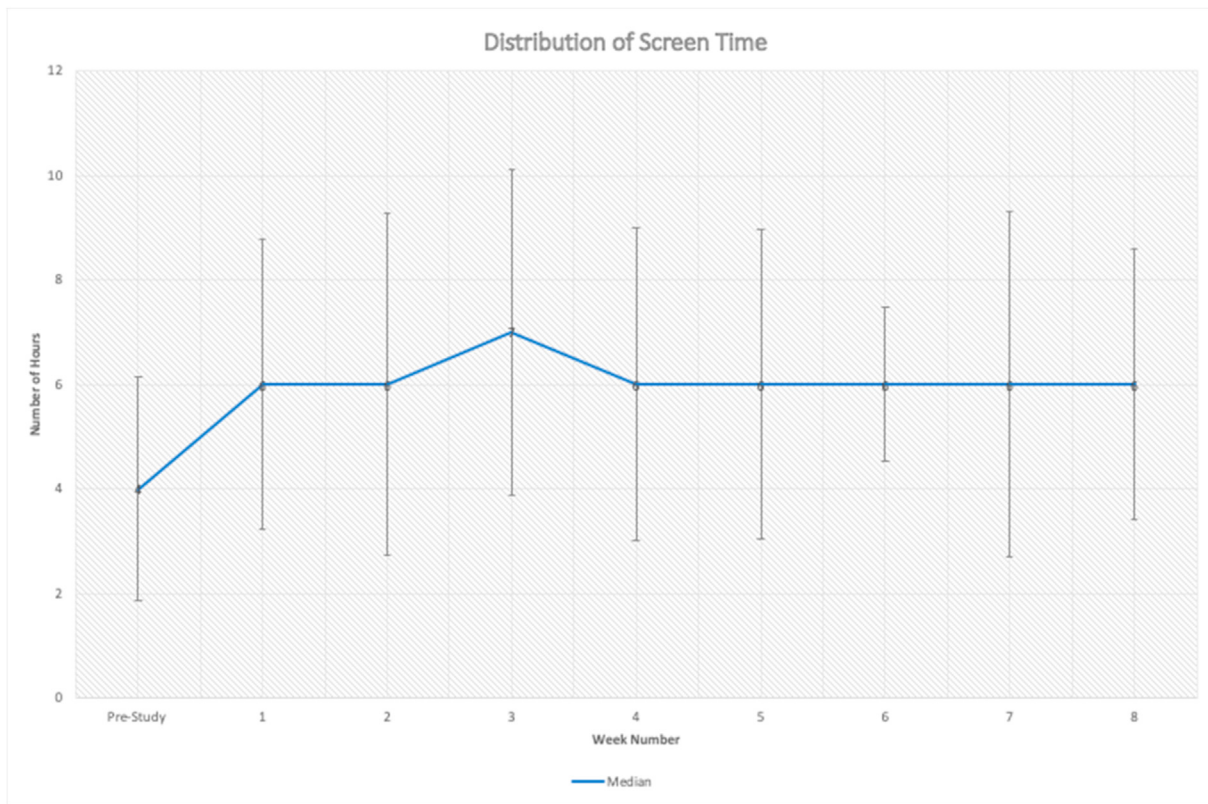


Fig. 5. Hours of screen time varied across the participants over the eight week period using the median±standard deviation.

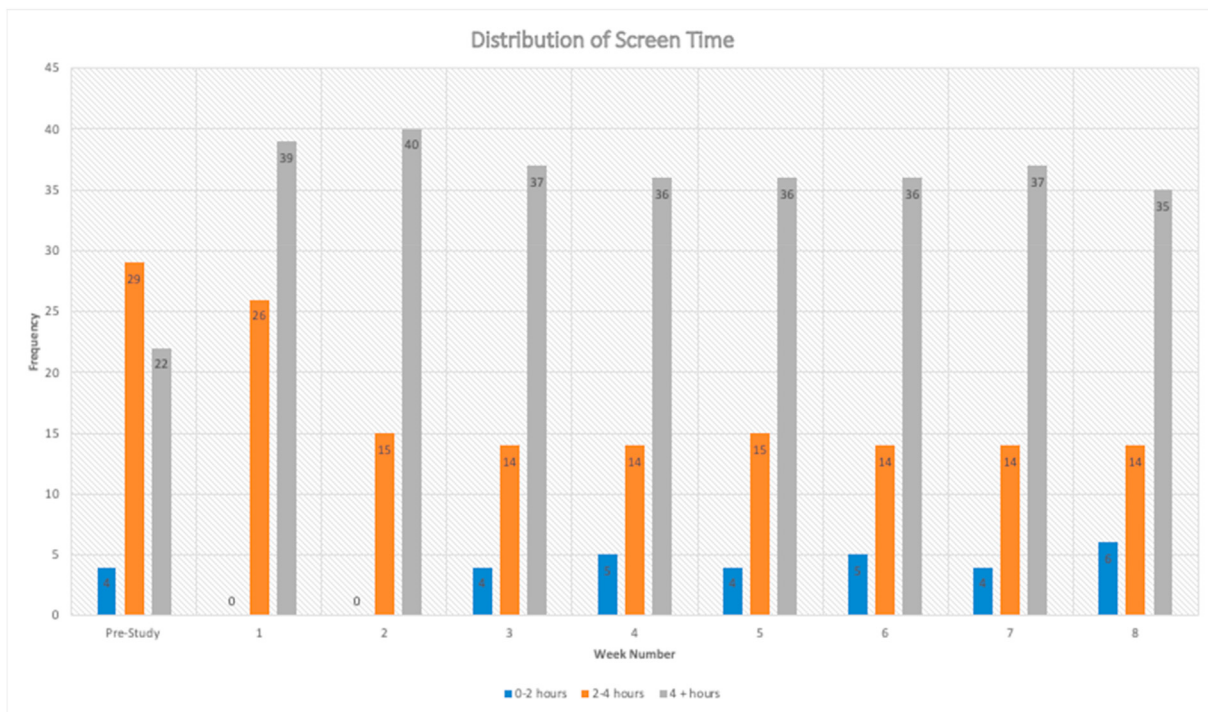


Fig. 6. Hours of screen time between 0-2 h; 2-4 h and over 4 h.

The sample size of 55 participants ensured widespread data could be obtained containing a variance of individual differences. However, this data was not generalisable to all teenagers who attend secondary education in the UK, due to the limited sample size. Despite this, as the

sample consists of only students, it is strong in population validity, in representing our target demographic. In order to overcome a low reliability that had arisen due to the small sample, researchers obtained data over an eight week period; this helped ensure that anomalous results

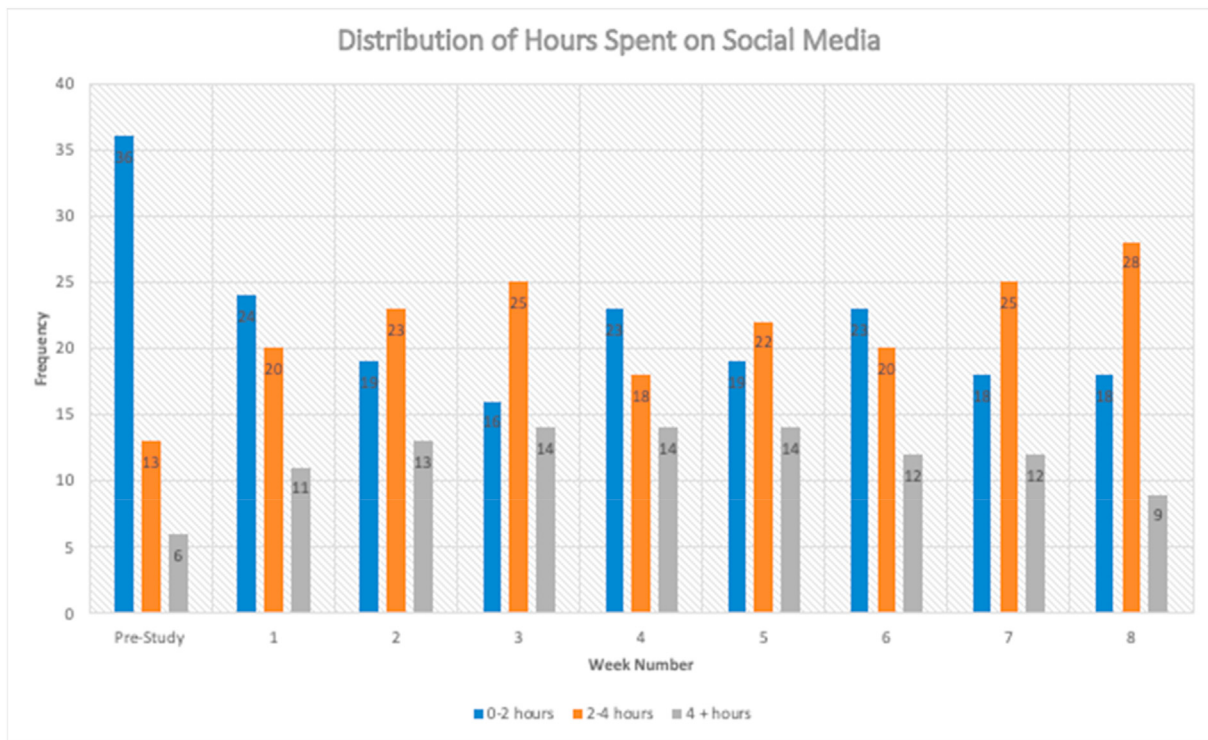


Fig. 7. Hours spent on Social Media.

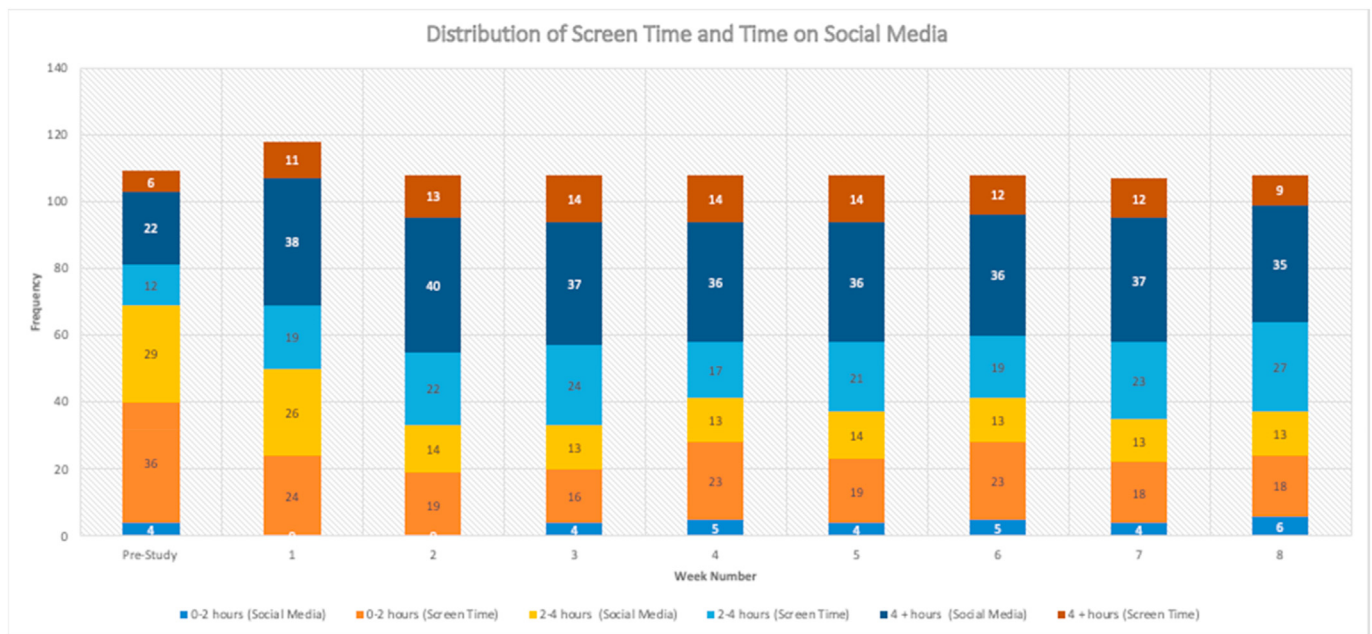


Fig. 8. Hours spent on Social Media combined with Screen Time.

were easily identified.

Situational extraneous factors for each participant when completing the questionnaires, prevented the procedure from being standardised for all participants, reducing reliability of conclusions. Confounding variables that may have affected results were: health, gender, home environment, personality type, facilities available and subjectivity. Specifically, the confounding variable of ‘subjective perception’ was a significant factor when considering the investigation, as one’s perception of ideal physical or mental health is likely to differ from another participant’s. The authors decided to choose the appropriate number of

questions to ensure participants would not find this time-consuming, and experience the order effect every week, whilst satisfactory to be able to target the real aims of the study assessing aspects of both mental and physical health.

A perceived weakness might be the lack of validated questionnaires, as questionnaires on impacts of health due to COVID-19 were non-existent. Due to the need for rapid commencement of the study with the aim of collecting real-time outcomes, a validation of a new questionnaire was not possible and therefore a pragmatic approach was chosen to create new questionnaires with self-selected criteria. The

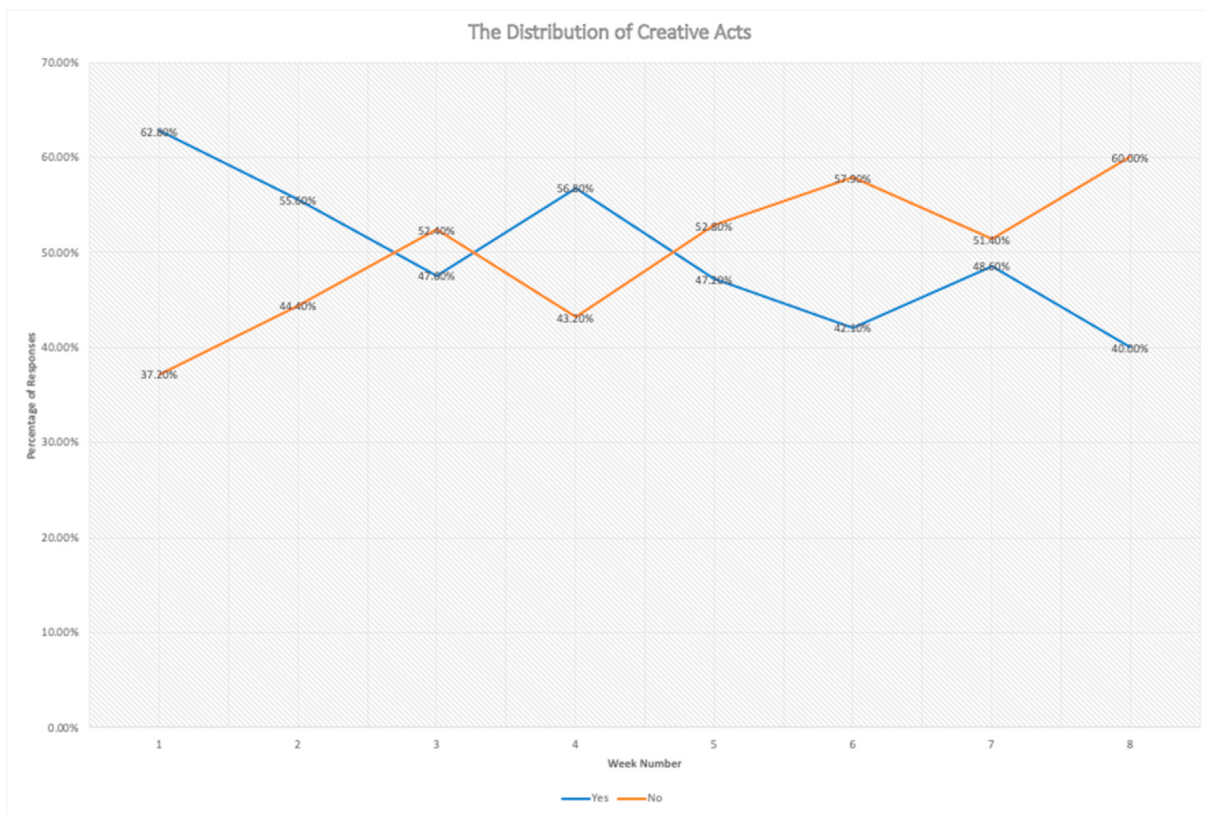


Fig. 9. Creativity of participants varied by showing whether or not they had undertaken something creative that week.

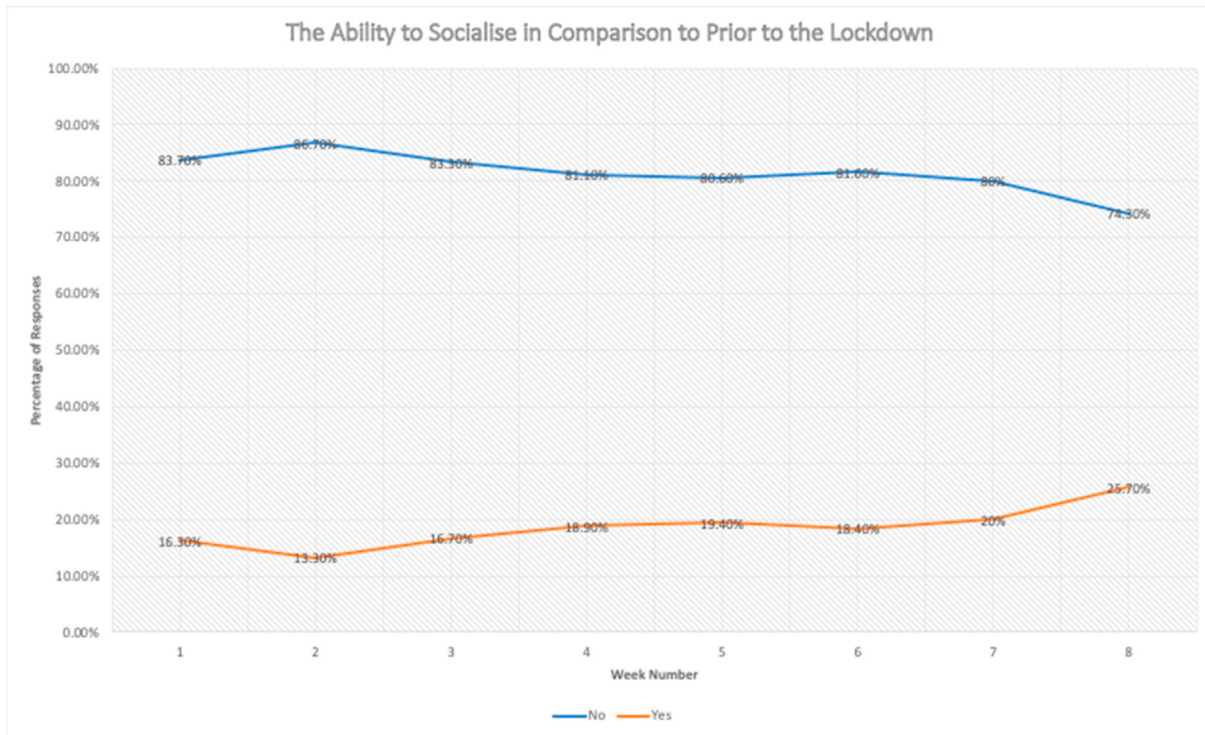


Fig. 10. A comparison in the level of interaction (i.e. ability to socialise with others) before and during lockdown.

authors chose to use the WHO ICF domains as the foundation to base the questionnaires on, to provide objective, universal measurements of health. As the authors were part of the target demographic, it was

possible to ensure that all questions within the questionnaires were specific towards the demographic, and would be able to assess the most important aspects of both mental and physical health of this group.

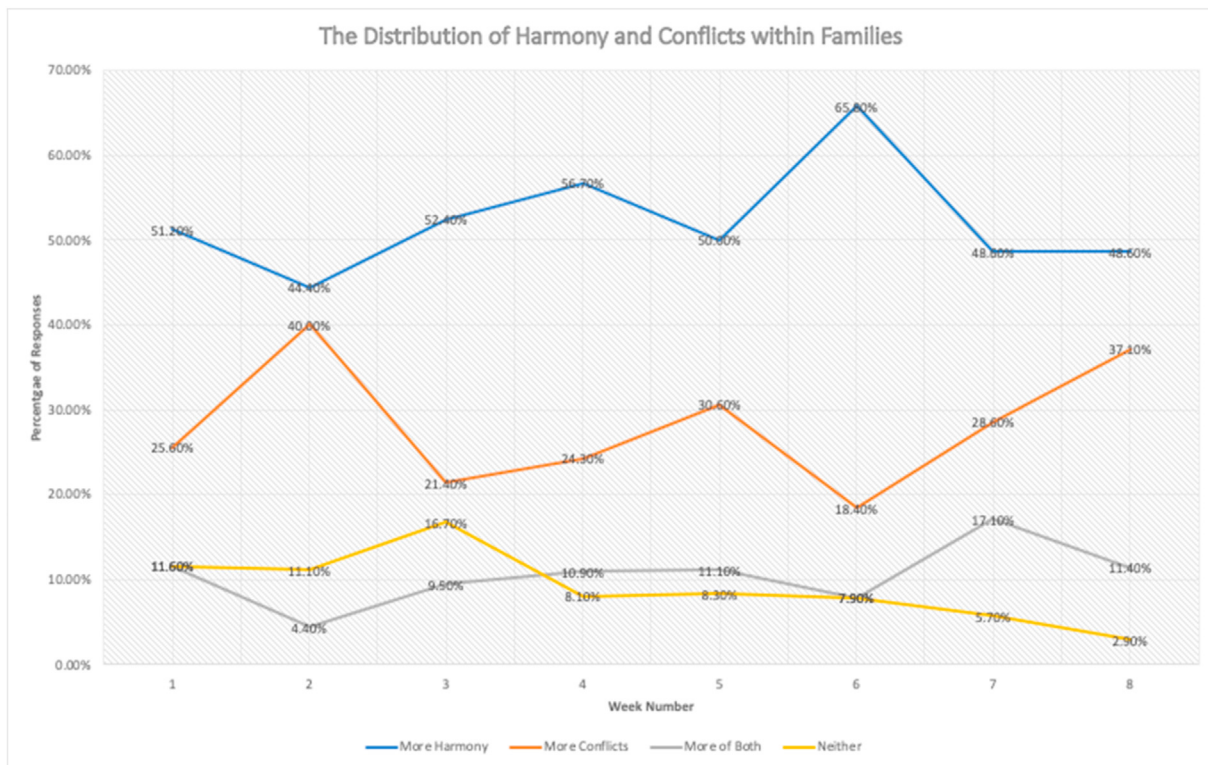


Fig. 11. The distribution of the amount of harmony and conflicts among families varied among participants.

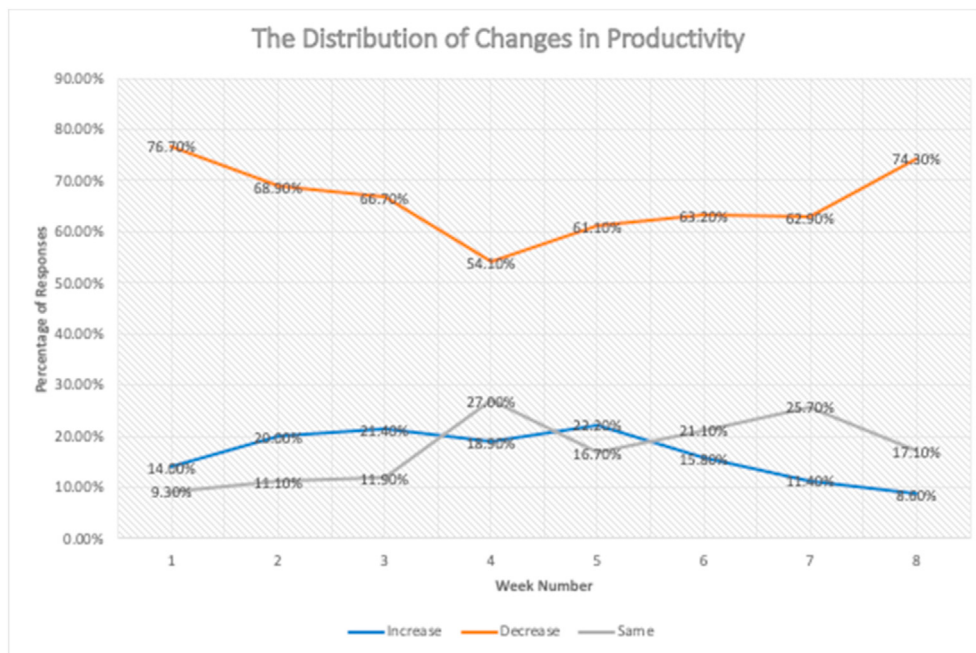


Fig. 12. Levels of productivity.

Furthermore, the authors did not discuss with participants before sending out questionnaires.

Due to the mixed sample, gender, race and ethnicity were not biased, however the cohort did not contain participants from a low socio-economic background, therefore the findings from the study are not generalisable. To the authors' knowledge this is the only prospective longitudinal study into self reported physical and mental wellbeing parameters in the UK during the COVID-19 lockdown. The authors had to

focus on a number of particularly relevant and interesting aspects of the study in the discussion. A comprehensive data report can be made available upon request as certain free text analysis also provided valuable insights into possible effects on mental health but could not be included due to text limitations.

5. Conclusion

Although the use of the self-reporting collection method introduced some subjectivity, as the perception of changes in health may differ among individuals, this study highlights that despite certain positive effects, the overall impact of lockdown during the COVID-19 pandemic has been negative, in regard to both physical and mental health for this cohort of young people in secondary education. As a prospective study conducted by students, this will provide the necessary information for health organisations to evaluate the effects of the lockdown and school closures on the teenage demographic. The long-term effects of the COVID-19 lockdown on the health and wellbeing of the nation will most likely be investigated over the coming months. This study albeit small and conducted by a team of young researchers will hopefully contribute to this knowledge.

Footnotes

Contributor and guarantor information: Noemi Jester and Premjeet Kang contributed equally and share first authorship. N Jester and P Kang are the guarantors of the study. The study conception and design was peer reviewed by Mrs Ann Clark, the principal at the time of writing of the institution and Mrs Sarah Shore-Nye, the head of pastoral care and vice-principal of the institution. Mrs Celina Anderson, the head of psychology at the institution, contributed to and peer reviewed data interpretation.

"The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted."

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"Competing interests: All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work."

Ethics approval: This study was approved by the senior leadership board of the institution. Before taking part in the study, all participants signed consent that informed them of all aspects of their participation in the study and their rights surrounding this participation.

The corresponding author affirms that the manuscript is an honest, accurate, and transparent account of the study being reported. No important aspects of the study have been omitted, and all discrepancies from the study as planned have been explained.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

We would like to acknowledge the dedication of all the participants (Noor Abdalla, Dorna Abdollahi, Alexandra Akins, Samara Ali, Yusuf Ali,

Shivani Arun, Ketevani Asatiani-Kalandaze, Simren Atwal, Aliyah Begum, Gemma Calthorpe, Anna Sofia David, Finn Epting, Alice Fenton, Emily Fox, Cathy Ge, Alice Green, Imogen Green, Carolin Gruss, Cornelius Gruss, Rishit Harsh, Aleesha Hassan, Madeleine Hope, Alisha Hussain, Maria Hussain, Elwira K., Sanika Kharwadkar, Hanna Kisiala, Carola Kirchhof, Ivy Lau, Krithika Manigandan, Gurjyot Mann, Ella Mason, Vedika Mathur, Avni Mehra, Aaisha Mughal, Arjun Narendran, Osha Patel, Zarina Patel, Rishika Prasad, Harriet Price, Angie Qiao, Charlie Raca, Khadeeja Rahman, Isobelle Russell, Jessica Sandhu, Zoe Stephens, Michelle Sum, Mattea Tettey-Enyo, Elizabeth Thomas, Gauri Varma, Hannah Watton, Zoe Yap, Zaynah Yakoob) and their contribution making this study possible.

Appendices.

Initial Pre-Study Questionnaire

Questions are applicable to the time prior to lockdown. *Required.

1. How many hours of sleep were you getting? From when to when were you sleeping? *
2. How many times a week were you exercising? For how long? *
3. What was your average screen time per day? (if unsure an estimate is fine) *
4. How many hours were you spending on social media? *
5. Do you feel that you have been affected by the mass hysteria surrounding panic buying and fake news, specifically on social media surrounding COVID-19? *
6. Do you think the government's decisions surrounding education will "make sure that pupils get the qualifications they need and deserve for their academic career" or do you think that pupils will be unrightfully impeded? *

Ongoing Questionnaire

Questions are applicable for the time since the lockdown commenced. *Required.

1. How many hours of sleep are you getting? From when to when are you sleeping? *
2. Are you going outside every day for exercise? If yes, for how long? (tick all that apply) *
3. Has your appetite increased or decreased? *
4. What is your current screen time? *
5. How long are you spending on social media per day? *
6. Do you think the impact of social media has changed to have more positive impacts (for example through #clapforNHS and #10beautifulwomen) or negative impacts (through notifications of increasing deaths and cases)? *
7. Have you noticed an increase in creativity personally/done anything creative? *
8. Do you feel you have the ability to socialise as much as you would usually? *
9. Has the lockdown created more conflicts or harmony among your family? *
10. Have you experienced more headaches/migraines/indigestion than you would usually? *
11. If consumed, have you noticed an increase in caffeine intake? *
12. If consumed, have you noticed an increase in alcohol consumption? *
13. In periods of online schooling, have you noticed a change in your productivity? *

Post-Study Questionnaire

This will act as a reflection on the past 8 weeks. *Required.

1. Has the lockdown caused a positive or negative change in your life-style? In what way? *
2. Since lockdown, has your physical health improved? (compared to before lockdown) *
3. Since lockdown, has your mental health improved? (compared to before lockdown) *
4. Generally, have you eaten healthier or unhealthier foods since lockdown started?*
5. Has the teaching during lockdown had an effect on your productivity? *
6. Have you learnt (not attempted but completed) a new skill during lockdown? *
7. Do you think the lack of interaction with others (compared to before lockdown) has influenced your health? *
8. Has the change in sleep schedule impacted your health?

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