


## Article

# Variations in Circadian Rhythmicity and Students' Gender-Related Psychological Conditions during the COVID-19 Lockdown

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**Abstract:** In the face of the COVID-19 pandemic experienced around the world, new student lifestyles have had an impact on their daily behavior. The purpose of this study was to examine post-traumatic stress associated with the initial COVID-19 crisis in students (N = 280) with a mean age of  $13 \pm 1.70$  and to determine the relationship between their reported daily behaviors in terms of their gender. The study was conducted primarily in Casablanca and Marrakech, the two cities most affected by the pandemic at the time of the study in Morocco in May 2020. Our sample consists of 133 high school students and 147 middle school students, 83.6% of whom are females. Students were asked to answer questions based on an Activity Biorhythm Questionnaire, the Post-Traumatic Stress Scale (Weathers et al., 1993), the Hamilton Scale (Hamilton, 1960), the Worry Domains Questionnaire (Tallis, Eyzencck, Mathews, 1992), and the Visual Analog Scale of Moods (VASM) (Stern et al., 1997). The results obtained confirm that there is a significant relationship between the circadian rhythm of some variables and gender in some activities such as academic study ( $p < 0.05$ ) and TV and Internet use ( $p < 0.05$ ) and was highly significant for physical activity ( $p = 0.001$ ), while others are not significant in relation to other schedules of the same variables or in relation to others. Likewise, for the psychological conditions, significant relationships with mood states and depressive tendencies were confirmed. In lockdown, the students' daily lives underwent changes in circadian rhythm and lifestyle. Therefore, it is necessary to treat their current psychological problems and avoid future complications.

**Keywords:** circadian rhythm; post-traumatic stress; lifestyle; psychological conditions



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## 1. Introduction

In the face of the alarming threats of coronavirus, researchers have addressed its effects on the mental health of populations around the world. Symptoms of mental health disorders are mainly felt by all individuals who are affected by the virus or who are confined by preventive measures, particularly in the most affected countries.

In Morocco, preventive measures of lockdown were officially declared from March 16 and were extended twice until June 10, exceeding a total of 70 days. During this period, the pace of life of Moroccans changed regarding their circadian activities, especially for children who previously had a rhythm of life framed by school.

Studies have shown that this period of isolation is likely to be particularly difficult for children and adolescents and may have a negative impact on their ability to successfully regulate their behavior and emotions [1]. Children and adolescents are aware of the dramatic impact of the COVID-19 epidemic and have experienced fears, uncertainty, physical and social isolation, and worry about missing school for an extended period of time [2]. School closures had a significant impact on their academic results [3].

In China, 22.6% of students reported depressive symptoms and 18.9% reported anxiety symptoms [4], while in Nepal, people were ill-prepared for the long-term mobility restriction. The social distance and isolation that accompany long-term confinement may be a risk factor for anxiety, mood disorders, and addiction and drinking disorders [5]. This is likely to lead to negative mental health outcomes in youth [6], due to the stress accompanying natural disasters, including health-related disasters. The effects of this stress may be increased for adolescents [7] due to their increased desire for autonomy and connection with peers [8].

This pandemic may not only increase levels of stress, anxiety and depression during the day, but may also disrupt sleep. Most importantly, because of the fundamental role that sleep plays in regulating emotions, sleep disturbances may have direct consequences on the emotional functioning of the next day [1].

With the COVID-19 pandemic, at least two factors beyond stress are also involved: the effects of lockdown and atypical work schedules [9].

Studies have shown that isolation from each other for a period can lead to desynchronization with the outside world [10], while others have shown that this isolation leads adolescents to a new lifestyle in which the use of media is increasingly common, which has negative effects on their sleep [11].

Many citizens may exercise less because of the cancellation of regular sports activities, limited opportunities to leave home, and having to balance the multiple demands of work and home schooling. Combined with eating more, this can lead to an increase in body weight [9], as eating more than usual is a natural response to stress [12].

Based on what was previously cited, this study aims to highlight the impact of circadian rhythms on daily activities and the psychological state of students related to their confinement due to the COVID-19 pandemic and their gender, assuming that gender affects the psychological conditions and circadian rhythmicity of the students.

## 2. Materials and Methods

### 2.1. Sample

Our sample includes 280 students (147 middle school and 133 high school students) with a mean age of  $13 \pm 1.70$  years, 83.6% of whom are females. The sample for this study includes 254 students from Casablanca and 16 from Marrakech, the first and the second cities where the pandemic was the most widespread at the time of the study (May 2020), respectively, and 10 from other Moroccan cities. Based on the personal information extracted from the student databases of their school administrations, we concluded that the students are from middle-class families, enrolled in public sector schools. Prior to lockdown, middle school students had school hours of 27 h per week for the first year, 30 h for the second year, and 34 h for the third year, while in high school their hours were 27, 34, and 31 for the first, second, and third years, respectively. However, during the period of lockdown, the school hourly volume decreased by about half, particularly among students who were not able to continue their online course throughout the three months of lockdown.

### 2.2. Measuring Instruments

- Daily Activities Biorhythm Questionnaire: We used online questionnaires for the collection of general information, including age, gender, grade level, city of confinement, information regarding the time and duration of daily activities (academic study, online school courses, housework, TV or web, nap, physical activity, phone calls, sleep (sleep and wake time, satisfaction and difficulty sleeping), mealtimes and other activities).
- Post-Traumatic Stress Scale (PCLS): A post-traumatic stress disorder self-report scale to analyze depressive tendency (Weathers F.W. et al., 1993), comprising 17 items that correspond to the symptoms of the DSM-III-R of PTSD and measure 3 subscales: repetition, avoidance, neurovegetative hyperactivity. It is rated on a 5-point Likert scale ranging from “not at all” to “extremely”. The psychometric characteristics showed

that the test–retest reliability was 0.96; the internal consistency (alpha coefficient) was 0.97 [13].

- **Hamilton Scale:** Aimed at assessing the severity of depression, it consists of 17 items known as HDRS-17: depressed mood, guilt, suicidal ideation, sleep disturbance, work and activities in general, slowed thinking and language, agitation, psychological and physical anxiety, somatic symptoms, sexual activity, hypochondria, weight loss, patient’s view of his or her own condition, daytime variations, depersonalization and derealization, delusional symptoms, obsessive and compulsive symptoms. The HDRS17 is a multiple-item questionnaire. For each item, a score of 0 to 4 points is assigned. At the end of the test, the total score is the sum of the points obtained for each item [14].
- **The Worry Domains Questionnaire (WDQ):** We used the Worry Domains Questionnaire developed by Tallis et al. (1992), which consists of 30 items to measure avoidance of discomfort to be inferred from Hamilton items, measuring 6 domains: relationships, lack of trust, future without goals, work incompetence and financial threats. It is rated on a 5-point Likert scale: not at all, somewhat, moderately, considerably and extremely [15].
- **Visual Analog Mood State Scale (VAMS):** This scale was designed by Huskinsson (1974), measuring seven visual analogue mood scales (VAMS), using vertical 100 mm lines and simple, schematic faces representing the following mood states: sad, afraid, angry, tired, energetic, happy, and confused [16].

### 2.3. Design

We used a quantitative approach by administering the tests to students from different school levels and different Moroccan cities during lockdown in order to show the impact of gender on biological rhythms and psychological conditions in students during this period.

### 2.4. Data Analysis

The data in our research were processed according to percentages, means, standard deviations, and  $p$  value for each of the circadian variables related to students’ psychological conditions by gender. The threshold of significance was set at  $p = 0.05$  and data were collected and processed by SPSS 23 (IBM, IC, Chicago, IL, USA).

### 2.5. Research Difficulties

Surveys were sent online to a sample of 506 students. A total of 46 of these students did not respond due to connectivity problems during the study period (two weeks). A total of 21 students were infected with coronavirus, 77 students were not psychologically able to interact with the study, and 82 others did not respond without any justification. As a result, 280 out of 506 students responded to the questionnaires and only 46 of them were males. The rate of responses from females exceeded that of males, which was a large limitation of the research.

## 3. Results

### 3.1. Sleep

The results for the sleep parameters are presented in Table 1. Regarding bedtime, 34% of students manage to sleep before midnight, while 65.9% do not sleep until after midnight and 30.1% go to sleep after 2 a.m. We also noticed that the rate of going to bed after 2 a.m. is significantly higher for males than that for females (7.2% vs. 22.9%;  $p < 0.05$ ), while we found no significant variation between males and females in bedtime schedules between 10 p.m. and 2 a.m. ( $\chi^2 = 5.898$ ,  $df = 3$ ,  $p = 0.117$ ).

**Table 1.** Variation in sleep parameters by gender. Data are presented in frequency and percentages.

Parameter		Gender						Chi2 Test
		Female		Male		Total		
		n	%	n	%	N	%	p Value
Bedtime	Before 10 p.m.	9	3.2%	0	00%	9	3.2%	ns
	10 p.m.–Midnight	74	26.5%	12	4.3%	86	30.8%	ns
	Midnight–2 a.m.	86	30.8%	14	5.0%	100	35.8%	ns
	After 2 a.m.	64	22.9%	20	7.2%	84	30.1%	0.031 *
Waking time	Before 8 a.m.	6	2.2%	0	0.0%	6	2.2%	ns
	8–10 a.m.	87	31.2%	10	3.6%	97	34.8%	0.042 *
	10–12 a.m.	78	28.0%	16	5.7%	94	33.7%	ns
	After 12 a.m.	62	22.2%	20	7.2%	82	29.4%	0.022 *
Sleep satisfaction	Satisfaction	57	20.4%	10	3.6%	67	24.0%	ns
Sleep difficulty	Difficulty	136	48.7%	28	10.0%	164	58.8%	ns

\* significant ( $p < 0.05$ ).

When waking up, the majority (63.1%) get up after 10 a.m., 29.4% of which get up after noon, compared to 37% who wake up before 10 a.m., 3.6% of whom are males. It was also observed that the waking up after 12 a.m. time was significantly higher for males ( $\text{Chi}2 = 7.61$ ,  $\text{df} = 3$ ,  $p < 0.049$ ), compared to females ( $p < 0.05$ ).

While 76% of our sample were not satisfied with their sleep and 58.8% showed difficulties falling asleep, we found no significant variation between males and females in sleep satisfaction ( $\text{Chi}2 = 0.156$ ,  $\text{df} = 1$ ,  $p < 0.693$ ) and sleep difficulty ( $\text{Chi}2 = 0.099$ ,  $\text{df} = 1$ ,  $p < 0.753$ ).

### 3.2. Biorhythms of Activities

Regarding circadian biorhythms, 26% of students prefer to perform their daily activities during the afternoon period from 3 p.m. to 7 p.m., against 18.3% of students who prefer to perform them between 7 p.m. and 10 p.m., of which 3.2% are males and 15.1% are females. In addition, 10.5% of students prefer the nighttime period (after midnight) in order to carry out their daily activities. On the other hand, 24.2% of students prefer the morning period from 10 a.m. to 3 p.m., compared to 7.8% of students who prefer to do their activities before 10 a.m. (Table 2).

**Table 2.** Variation in the scheduling of daily activities by gender. The data are presented in frequency and percentages.

Parameter	Period	Gender				Total	
		Female		Male		N	% of Total
		n	% of Total	n	% of Total		
Timing of daily activities *	Before 10 a.m.	94	6.2%	24	1.6%	118	7.8%
	10 a.m.–3 p.m.	330	21.7%	38	2.5%	368	24.2%
	3–7 p.m.	325	21.4%	70	4.6%	395	26.0%
	7–10 p.m.	230	15.1%	48	3.2%	278	18.3%
	10–12 p.m.	168	11.1%	32	2.1%	200	13.2%
	After 12 p.m.	136	9.0%	24	1.6%	160	10.5%
Total		1283	84.5%	236	15.5%	1519	100.0%

\* Daily activities: courses review, school online courses, housework, TV or web, napping, physical activity, phone calls, other activities.

The majority of daily activities were carried out after 3 p.m. A total of 40% of students use the online school course tracking system and 42.4% take a nap between 3 p.m. and 7 pm. A total of 51.8% of students review their courses (and the male gender is significantly higher than the female) between 7 p.m. and 10 p.m. ( $p < 0.05$ ).

Concerning phone calls, a notable gender effect was observed ( $\text{Chi}^2 = 22.887$ ,  $\text{df} = 5$ ,  $p = 0.000$ ). A total of 25.1% of students make their calls between 10 p.m. and midnight, with the male rate being 8.4%. This was significantly higher than the females ( $p = 0.001$ ). Similarly, for physical activity between 3 p.m. and 7 p.m., 8.1% of males and 8.1% of females participate in physical activity, and the male gender is highly significant compared to the female ( $p = 0.001$ ).

Compared to TV and Internet use, the variation is very significant ( $\text{Chi}^2 = 15.183$ ,  $\text{df} = 5$ ,  $p = 0.010$ ). It was observed that the rate of TV and Internet use by the female gender (24.8%) was significantly higher than that of the males between 7 p.m. and 10 p.m. ( $p < 0.05$ ), while the male rate was significantly higher than the female rate (18.8%) after 12 p.m. ( $p < 0.05$ ).

For the morning period, 47.6% of students prefer to do housework and 34.9% prefer physical activity between 10 a.m. and 3 p.m., whereas only 18.8% of students are physically active before 10 a.m. In the same period, the rate of males doing other activities is very significant compared to the females ( $p = 0.004$  to  $0.01$ ).

While we found no significant variation between males and females in the timing of courses review ( $\text{Chi}^2 = 10.449$ ,  $\text{df} = 5$ ,  $p = 0.063$ ), for other periods of the day we found online school courses ( $\text{Chi}^2 = 3.056$ ,  $\text{df} = 5$ ,  $p = 0.691$ ), housework ( $\text{Chi}^2 = 7.495$ ,  $\text{df} = 5$ ,  $p = 0.186$ ), and nap time ( $\text{Chi}^2 = 1.371$ ,  $\text{df} = 3$ ,  $p = 0.712$ ) to be significant (Table 3).

### 3.2.1. Schedules of Mealtimes

Table 4 presents the students' mealtimes during the day. At breakfast, a percentage of 26.8% of students eat their meal between 8 a.m. and 10 a.m., with the female gender significantly higher than the male ( $p < 0.05$ ); 44.4% eat between 10 a.m. and noon, of which 35.8% are females, while 27.2% eat after 12 a.m., a period when males have a significantly higher rate than females ( $p < 0.05$ ).

At lunchtime, 54.5% of the students had their lunch between 2 p.m. and 4 p.m., while 43.2% of the students had their dinner between 10 p.m. and midnight.

Based on the results obtained, we noticed that there was no significant variation between males and females in terms of lunch ( $\text{Chi}^2 = 4.043$ ,  $\text{df} = 2$ ,  $p = 0.132$ ) and dinner times ( $\text{Chi}^2 = 3.782$ ,  $\text{df} = 3$ ,  $p = 0.286$ ).

### 3.2.2. Duration of Activities

Students allocate their time to nine activities during the day, including academic study, online classes, housework, TV or Internet use, nap, phone calls, physical activity (PA), other activities, and isolation.

A large majority spend more time watching TV and using the Internet (24.7%), or making phone calls (17.1%) than reviewing courses (13.4%). This was evidenced by the fact that 55.2% of students spent 2–5 h or more watching TV or using the Internet and 55.3% spent 1–5 h or more making phone calls. For this same variable, the male rate is significantly higher than female ( $p < 0.05$ ) for the period of 1–2 h.

Concerning academic study ( $\text{Chi}^2 = 13.299$ ,  $\text{df} = 5$ ,  $p = 0.021$ ), 25.3% of students spend 1–2 h and the male rate is very significant over the female ( $p = 0.004$  to  $0.01$ ), while 58.3% of students spend 30 min–2 h for online school courses against 8.4% between 3–4 h, a time at which the male gender is significantly higher than the female ( $p < 0.05$ ).

A total of 62.8% of students spend 10–30 min on physical activity, mainly females ( $p < 0.05$ ) while for the time between 30 min and 1 h, the male gender is highly significant compared to the female's ( $p = 0.001$ ). Gender therefore has a highly significant effect ( $\text{Chi}^2 = 18.717$ ,  $\text{df} = 2$ ,  $p = 0.001$ ) in relation to the duration of physical activity.

Table 3. Frequency of activity schedules by gender among students.

Students		Before 10 a.m.			10 a.m.–3 p.m.			3–7 p.m.			7–10 p.m.			10–12 p.m.			After 12 p.m.		
		N	%	<i>p</i>	N	%	<i>p</i>	N	%	<i>p</i>	N	%	<i>p</i>	N	%	<i>p</i>	N	%	<i>p</i>
Academic study time	Female	12	4.7%	ns	48	19.0%	-	107	42.3%	ns	30	11.9%	ns	10	4.0%	ns	4	1.6%	ns
	Male	2	0.8%	ns	4	1.6%	-	24	9.5%	ns	12	4.7%	0.022 *	0	0.0%	ns	0	0.0%	ns
	Total	14	5.5%	-	52	20.6%	-	131	51.8%	-	42	16.6%	-	10	4.0%	-	4	1.6%	-
Online school courses time	Female	14	6.5%	ns	61	28.4%	-	72	33.5%	ns	22	10.2%	ns	12	5.6%	ns	4	1.9%	ns
	Male	2	0.9%	ns	10	4.7%	-	14	6.5%	ns	4	1.9%	ns	0	0.0%	ns	0	0.0%	ns
	Total	16	7.4%	-	71	33.0%	-	86	40.0%	-	26	12.1%	-	12	5.6%	-	4	1.9%	-
Housework time	Female	28	13.3%	ns	92	43.8%	-	40	19.0%	ns	12	5.7%	ns	10	4.8%	ns	2	1.0%	ns
	Male	6	2.9%	ns	8	3.8%	-	8	3.8%	ns	4	1.9%	ns	0	0.0%	ns	0	0.0%	ns
	Total	34	16.2%	-	100	47.6%	-	48	22.9%	-	16	7.6%	-	10	4.8%	-	2	1.0%	-
TV or Internet time	Female	2	0.8%	ns	22	8.3%	-	26	9.8%	ns	66	24.8%	0.028 *	56	21.1%	ns	50	18.8%	ns
	Male	2	0.8%	ns	2	0.8%	-	2	0.8%	ns	6	2.3%	ns	14	5.3%	ns	18	6.8%	0.011 **
	Total	4	1.5%	-	24	9.0%	-	28	10.5%	-	72	27.1%	-	70	26.3%	-	68	25.6%	-
Nap time	Female	0	0.0%	ns	18	27.3%	-	22	33.3%	ns	6	9.1%	ns	8	12.1%	ns	-	-	-
	Male	0	0.0%	ns	2	3.0%	-	6	9.1%	ns	2	3.0%	ns	2	3.0%	ns	-	-	-
	Total	0	0.0%	-	20	30.3%	-	28	42.4%	-	8	12.1%	-	10	15.2%	-	-	-	-
Physical activity time	Female	24	16.1%	ns	44	29.5%	-	12	8.1%	ns	17	11.4%	ns	16	10.7%	ns	4	2.7%	ns
	Male	4	2.7%	ns	8	5.4%	-	12	8.1%	0.001 ***	8	5.4%	ns	0	0.0%	ns	0	0.0%	ns
	Total	28	18.8%	-	52	34.9%	-	24	16.2%	-	25	16.8%	-	16	10.7%	-	4	2.7%	-
Phone calls time	Female	8	4.2%	ns	16	8.4%	-	22	11.5%	ns	49	25.7%	ns	32	16.8%	ns	34	17.8%	ns
	Male	4	2.1%	ns	0	0.0%	-	0	0.0%	ns	6	3.1%	ns	16	8.4%	0.001 ***	4	2.1%	ns
	Total	12	6.3%	-	16	8.4%	-	22	11.5%	-	55	28.8%	-	48	25.1%	-	38	19.9%	-
Other activities time	Female	6	4.0%	ns	29	19.2%	-	24	15.9%	ns	28	18.5%	ns	24	15.9%	ns	22	14.6%	ns
	Male	4	2.6%	0.005 ***	4	2.6%	-	4	2.6%	ns	6	4.0%	ns	0	0.0%	ns	0	0.0%	ns
	Total	10	6.6%	-	33	21.9%	-	28	18.5%	-	34	22.5%	-	24	15.9%	-	22	14.6%	-

\*\*\* Highly significant ( $p = 0.001$ ); \*\* Very significant ( $p = 0.004$  to  $0.01$ ); \* significant ( $p < 0.05$ ).

**Table 4.** Percentages of students' daily meal schedules by gender during the period of confinement.

		Gender				Total	Chi2 Test		
		Female		Male				N	p Value
		n	%	n	%				
Breakfast time	Before 8 a.m.	4	1.6%	0	0.0%	4	1.6%	ns	
	8–10 a.m.	63	24.5%	6	2.3%	69	26.8%	0.020 *	
	10–12 a.m.	92	35.8%	22	8.6%	114	44.4%	ns	
	After 12 a.m.	52	20.2%	18	7.0%	70	27.2%	0.046 *	
Lunch time	12 a.m.–2 p.m.	68	24.5%	8	2.9%	76	27.4%	ns	
	2–4 p.m.	125	45.1%	26	9.4%	151	54.5%	ns	
	After 4 p.m.	38	13.7%	12	4.3%	50	18.1%	ns	
Dinner time	Before 8 p.m.	11	4.2%	0	0.0%	11	4.2%	ns	
	8–10 p.m.	86	33.2%	18	6.9%	104	40.2%	ns	
	10–12 p.m.	94	36.3%	18	6.9%	112	43.2%	ns	
	After 12 p.m.	24	9.3%	8	3.1%	32	12.4%	ns	

\* significant ( $p < 0.05$ ).

Furthermore, 55.9% of students spend less than 30 min–1 h doing housework, 49.4% spend 30 min–2 h napping and 45.1% spend 30 min–1 h doing other activities, depending on gender ( $\text{Chi}2 = 21.361$ ,  $\text{df} = 5$ ,  $p = 0.001$ ).

Faced with these daily activities, the students spend more time isolated in their rooms away from the rest of their family members. A total of 60.3% of students spend 2–6 h/d in isolation, knowing that their duration of isolation is significantly affected by gender ( $\text{Chi}2 = 10.048$ ,  $\text{df} = 3$ ,  $p = 0.018$ ), so that male rate is very significant compared to the female rate ( $p = 0.004$  to  $0.01$ ) for the duration of more than 6 h/d.

There is no significant relationship between gender and the duration of housework ( $\text{Chi}2 = 7.991$ ,  $\text{df} = 5$ ,  $p = 0.157$ ), TV or Internet ( $\text{Chi}2 = 9.473$ ,  $\text{df} = 5$ ,  $p = 0.092$ ) and napping ( $\text{Chi}2 = 4.361$ ,  $\text{df} = 5$ ,  $p = 0.499$ ) (Table 5).

**Table 5.** Variation in the duration of daily activities by gender. Data are presented in frequency and percentage.

Parameters	Duration	Gender				Total	Chi2 Test		
		Female		Male				N	p Value
		n	%	n	%				
Academic study duration	Less than 30 min	12	4.6%	2	0.8%	14	5.4%	ns	
	30 min–1 h	34	13.0%	10	3.8%	44	16.9%	ns	
	1–2 h	48	18.4%	18	6.9%	66	25.3%	0.004 ***	
	2–3 h	50	19.2%	4	1.5%	54	20.7%	ns	
	3–4 h	44	16.9%	4	1.5%	48	18.4%	0.037 *	
	More than 5 h	31	11.9%	4	1.5%	35	13.4%	ns	
Online school courses duration	Less than 30 min	36	15.2%	6	2.5%	42	17.7%	ns	
	30 min–1 h	38	16.0%	10	4.2%	48	20.3%	ns	
	1–2 h	80	33.8%	10	4.2%	90	38.0%	ns	
	2–3 h	22	9.3%	2	0.8%	24	10.1%	ns	
	3–4 h	14	5.9%	6	2.5%	20	8.4%	ns	
	More than 5 h	13	5.5%	0	0.0%	13	5.5%	ns	

Table 5. Cont.

Parameters	Duration	Gender						Chi2 Test
		Female		Male		Total		
		n	%	n	%	N	%	p Value
Housework duration	Less than 30 min	46	20.1%	10	4.4%	56	24.5%	ns
	30 min–1 h	62	27.1%	10	4.4%	72	31.4%	ns
	1–2 h	47	20.5%	2	0.9%	49	21.4%	ns
	2–3 h	28	12.2%	4	1.7%	32	14.0%	ns
	3–4 h	10	4.4%	0	0.0%	10	4.4%	ns
	More than 5 h	10	4.4%	0	0.0%	10	4.4%	ns
TV or Internet duration	Less than 30 min	20	7.3%	8	2.9%	28	10.2%	ns
	30 min–1 h	45	16.4%	4	1.5%	49	17.8%	ns
	1–2 h	40	14.5%	6	2.2%	46	16.7%	ns
	2–3 h	36	13.1%	8	2.9%	44	16.0%	ns
	3–4 h	36	13.1%	4	1.5%	40	14.5%	ns
	More than 5 h	52	18.9%	16	5.8%	68	24.7%	ns
Nap duration	Less than 30 min	19	22.4%	4	4.7%	23	27.1%	ns
	30 min–1 h	16	18.8%	4	4.7%	20	23.5%	ns
	1–2 h	18	21.2%	4	4.7%	22	25.9%	ns
	2–3 h	6	7.1%	0	0.0%	6	7.1%	ns
	3–4 h	6	7.1%	0	0.0%	6	7.1%	ns
	More than 5 h	8	9.4%	0	0.0%	8	9.4%	ns
Phone calls duration	Less than 30 min	35	17.6%	6	3.0%	41	20.6%	ns
	30 min–1 h	44	22.1%	4	2.0%	48	24.1%	ns
	1–2 h	30	15.1%	10	5.0%	40	20.1%	0.026 *
	2–3 h	20	10.1%	0	0.0%	20	10.1%	ns
	3–4 h	14	7.0%	2	1.0%	16	8.0%	ns
	More than 5 h	28	14.1%	6	3.0%	34	17.1%	ns
Physical activity duration	10–30 min	102	53.4%	18	9.4%	120	62.8%	0.028 *
	30 min–1 h	31	16.2%	20	10.5%	51	26.7%	0.001 ***
	More than 1 h	20	10.5%	0	0.0%	20	10.5%	ns
	Total	153	80.1%	38	19.9%	191	100.0%	ns
Other activities duration	Less than 30 min	26	17.0%	2	1.3%	28	18.3%	ns
	30 min–1 h	57	37.3%	12	7.8%	69	45.1%	ns
	1–2 h	36	23.5%	2	1.3%	38	24.8%	ns
	2–3 h	8	5.2%	0	0.0%	8	5.2%	ns
	3–4 h	0	0.0%	2	1.3%	2	1.3%	ns
	More than 5 h	8	5.2%	0	0.0%	8	5.2%	ns
Duration of isolation	Less than 2 h/d	97	34.8%	14	5.0%	111	39.8%	ns
	2–4 h/d	54	19.4%	12	4.3%	66	23.7%	ns
	4–6 h/d	34	12.2%	2	0.7%	36	12.9%	ns
	More than 6 h/d	48	17.2%	18	6.5%	66	23.7%	0.007 **

\*\*\* Highly significant ( $p = 0.001$ ); \*\* Very significant ( $p = 0.004$  to  $0.01$ ); \* significant ( $p < 0.05$ ). h: hour; d: day.



### 3.3. Mood States (VASM)

According to Table 6, male students find it more difficult to fall asleep in lockdown ( $2.13 \pm 1.05$ ) and suffer more of disturbed sleep at night, while  $2.16 \pm 1.05$  is the mean result for students who show physical tiredness in lockdown, with the males being 0.23 lower than the females. Nevertheless, the good humor for females was represented by a mean of  $1.60 \pm 0.25$ , which is 0.51 higher than the male mean in lockdown. This explains why the female gender is significantly higher than males ( $p < 0.05$ ) for the good humor variable. Gender has no significant effect on the rest of the mood variations.

**Table 6.** Means and frequencies of mood states by gender.

Mood States Parameters	Gender			Chi2 Test <i>p</i> Value
	Female	Male	Total	
	Mean $\pm$ sd	Mean $\pm$ sd	Mean $\pm$ sd	
Pandemic anxiety	1.68 $\pm$ 0.30	1.83 $\pm$ 0.98	1.71 $\pm$ 0.64	ns
Dynamics during lockdown	1.30 $\pm$ 0.28	.91 $\pm$ 0.19	1.24 $\pm$ 0.22	ns
Sleep during lockdown	1.97 $\pm$ 0.27	2.13 $\pm$ 1.05	1.99 $\pm$ 0.87	ns
In shape during lockdown	1.63 $\pm$ 0.24	1.74 $\pm$ 0.98	1.65 $\pm$ 0.68	ns
Physical tiredness during lockdown	2.12 $\pm$ 0.91	2.35 $\pm$ 1.20	2.16 $\pm$ 1.05	ns
Good humor during lockdown	1.60 $\pm$ 0.25	1.09 $\pm$ 0.65	1.51 $\pm$ 0.45	0.019 *
Lockdown clumsiness	1.28 $\pm$ 0.31	1.17 $\pm$ 0.66	1.26 $\pm$ 0.49	ns
Subjective vigilance during lockdown	49.30 $\pm$ 12.55	49.11 $\pm$ 7.57	49.27 $\pm$ 8.81	ns
General mood states during lockdown	50.07 $\pm$ 10.11	49.96 $\pm$ 8.95	50.05 $\pm$ 9.65	ns

\* significant ( $p < 0.05$ ).

### 3.4. Post-Traumatic Stress, Avoidance and Depressive Tendencies (PCLS and HDRS-17)

The results of the measurement of post-traumatic stress, avoidance behavior and depressive tendencies are presented in Table 7.

Students had a mean of  $1.76 \pm 1.17$  in terms of repeating images of the pandemic in their thoughts. In terms of avoiding hearing or seeing visual and/or auditory information about the pandemic, students had a mean of  $1.85 \pm 1.34$ , while in terms of avoidance behavior, they had  $18.46 \pm 13.36/40$  pts versus  $14.29 \pm 10.83/40$  pts for discomfort felt after lockdown.

A mean of  $2 \pm 1.33$  expresses the sadness of the students during the lockdown period, i.e., half, while  $1.96 \pm 1.45$  feel guilty and perceive the pandemic as a punishment, with males ( $2.22 \pm 1.36$ ) feeling guiltier than females ( $1.91 \pm 1.46$ ).

A mean of  $2.03 \pm 1.54$  of students have lost interest in schoolwork and  $2.03 \pm 1.49$  suffer from slow actions and thoughts in lockdown.

The students had a mean of  $1.78 \pm 1.37$  regarding agitation, for which the female rate is very significant compared to the male ( $p = 0.004$  to  $0.01$ ) and by a mean of  $1.78 \pm 1.50$  regarding mental anxiety. They appear more nervous during lockdown.

Similarly, for lack of appetite, a mean of  $1.38 \pm 1.45$  represents the rate of students suffering from gastrointestinal symptoms, where the female gender is significantly higher than the male ( $p < 0.05$ ).

**Table 7.** Means and standard deviations of variables from tests of post-traumatic stress, avoidance behavior and Hamilton's depressive tendency in students and their gender effects.

	Gender						Chi2 Test <i>p</i> Value
	Female		Male		Total		
	Mean	sd	Mean	sd	Mean	sd	
Post-traumatic stress scale							
Repetition-PCLS	1.82	1.16	1.50	1.21	1.76	1.17	ns
Avoidance-PCLS	1.91	1.32	1.54	1.37	1.85	1.34	ns
Neurovegetative hyperactivity	1.35	1.24	1.46	1.28	1.36	1.24	ns
Avoidance behavioral test							
Avoidance score/40 pts	19.06	13.23	15.43	13.74	18.46	13.36	ns
Discomfort score/40 pts	14.59	11.11	12.72	9.25	14.29	10.83	ns
Scale of Hamilton depressive tendency during the lockdown period							
Depressed mood: More sadness in lockdown	2.03	1.38	1.83	1.02	2.00	1.33	ns
Guilt: The pandemic is a punishment	1.91	1.46	2.22	1.36	1.96	1.45	ns
Despair: Life is not worth living	1.01	0.48	0.74	0.27	0.96	0.42	ns
Insomnia: Difficulty falling asleep in lockdown Insomnia in the middle of the night	1.38	1.49	1.39	1.42	1.38	1.48	ns
Morning insomnia: Sleep disturbed at night in lockdown	1.50	1.51	1.39	1.48	1.48	1.50	ns
Morning Insomnia: Wake up early without wanting to go back to sleep	1.14	1.37	1.00	1.58	1.11	1.40	ns
Schoolwork: Interest: Loss of interest in schoolwork	2.00	1.57	2.17	1.39	2.03	1.54	ns
Schoolwork: Interest: Efficacy: Lack of academic reproducibility in lockdown	1.86	1.49	1.48	1.22	1.80	1.45	ns
Slowness: Slow actions and thoughts in lockdown	1.97	1.47	2.30	1.53	2.03	1.49	ns
Agitation: Agitation in lockdown	1.87	1.37	1.30	1.24	1.78	1.37	0.010 **
Psychic Anxiety: More nervous in lockdown	1.79	1.53	1.74	1.34	1.78	1.50	ns
Somatic Anxiety: New discomforts in lockdown	1.43	1.43	1.00	1.12	1.36	1.39	ns
Gastrointestinal Symptoms: Confinement appetite problems	1.47	1.50	0.91	1.07	1.38	1.45	0.017 *
Hypochondria: Health concerns in lockdown	1.74	1.48	1.52	1.57	1.70	1.49	ns
Weight loss in lockdown	0.85	1.31	0.65	0.92	0.81	1.26	ns
Weight gain in lockdown	0.96	1.35	0.91	1.30	0.95	1.34	ns

\*\* Very significant ( $p = 0.004$  to  $0.01$ ); \* significant ( $p < 0.05$ ).

### 3.5. Worry Domains (WDQ)

According to the two scales for measuring concern, it appears that students' concerns were above average for nine different variables, three of which are related to their environment and their financial capacity, while the other six are related to their schooling. The results are presented in Table 8.

**Table 8.** Variation in areas of concern by gender. The data are presented in means and standard deviations.

	Gender						Chi2 Test <i>p</i> Value
	Female		Male		Total		
	Mean	sd	Mean	sd	Mean	sd	
Relationship with others: Need of friends and co-workers	2.38	1.36	2.26	1.31	2.36	1.35	ns
Lack of trust: Loss of confidence in the health care system	1.56	1.35	1.78	1.43	1.59	1.36	ns
Future without goals: Fear of reduced employment	2.17	1.45	2.30	1.53	2.19	1.47	ns
Incompetence at work: Ineffectiveness at teleworking	1.84	1.44	0.74	0.80	1.66	1.41	0.001 ***
Financial Threat: Decreases in family and personal budgets	2.06	1.47	2.52	1.22	2.14	1.44	0.047 *
Physical threat: Fear of getting sick	2.43	1.42	2.70	1.31	2.47	1.40	ns
Concerns about understanding online courses	2.94	1.25	3.09	1.07	2.96	1.22	ns
Concern about end-of-year exams	3.16	1.24	3.48	1.03	3.21	1.21	ns
Fear of contamination at school	2.44	1.43	2.17	1.51	2.39	1.45	ns
Concern about scheduling remedial classes	2.58	1.54	3.13	1.24	2.67	1.51	0.024 *
Concern about extending studies in July	2.49	1.53	2.52	1.57	2.49	1.53	ns
Concern about scheduling exams after July	2.60	1.47	3.07	1.31	2.67	1.45	0.045 *

\*\*\* Highly significant ( $p = 0.001$ ); \* significant ( $p < 0.05$ ).

More than half of the students represented by a mean of  $2.36 \pm 1.35$  expressed the need for peers, compared to a mean of  $2.19 \pm 1.47$  for students who expressed fear of job loss or even fear of a decrease in family and personal budgets ( $2.14 \pm 1.44$ ), especially for the males whose rates were significantly higher than females ( $p < 0.05$ ).

Furthermore, their concern about understanding online courses is highly expressed with a mean of  $2.96 \pm 1.22$ , while their concern about exams at the end of the year is more marked with a mean of  $3.21 \pm 1.21$ , which shows their great concern during lockdown.

Students also showed fear of contamination at school ( $2.39 \pm 1.45$ ), or fear of getting sick ( $2.47 \pm 1.40$ ), while their concern about planning remedial measures ( $2.67 \pm 1.51$ ) was significantly higher for both males and females ( $p < 0.05$ ), and slightly higher than their concern about extending their studies in July ( $2.49 \pm 1.53$ ), which was significantly higher for males ( $p < 0.05$ ).

The ineffectiveness at teleworking variable is represented by a mean of  $1.66 \pm 1.41$ , and the female rate is significantly higher compared to the male ( $p = 0.001$ ).

#### 4. Discussion

Our study focuses on students' rhythm of life during the period of lockdown and the impact of confinement on their lifestyle in terms of gender. Variables addressed in our research include sleep, daily activity biorhythm, mood states, post-traumatic stress, avoidance behavior, depressive tendencies, and worry domains.

According to the results obtained, the hypothesis that our study sought to address was partially confirmed. The gender effect affects the temporality of a number of variables, including sleep, meal intake, physical activity, mood states, and many others.

Sleep plays an essential role in the growth, development and health of adolescents [17]. The quality of sleep is crucial for healthy living. Any stressful event, whether related to a person's personal life or to natural disasters that threaten psychological or physical well-being, can lead to sleep disturbances, especially in vulnerable individuals [9].

Both genders in our study suffered from poor sleep habits during the periods of lockdown, particularly late bedtime [18]. A total of 65.9% of students do not sleep until after midnight and 30.1% of them stay up past 2 a.m.; regarding late awakenings, the majority (63.1%) get up after 10 a.m., 29.4% of whom get up after noon; sleep dissatisfaction was shown by 76% and difficulty falling asleep at night by 58.8%. These indices define poor sleep quality [19].

Late bedtime in adolescence predicts multiple serious risk behaviors and health problems in young adults [20]. One study showed that a misalignment between the time of the sleep-wake cycle and endogenous circadian rhythm deteriorates attention [21], another confirmed that late bedtime (after 10 p.m.) in adolescents was associated with an increased likelihood of mood disorder, substance use disorder, behavioral disorder, mental disorder, smoking, poor perceived mental health, and poor perceived physical health [22]. This suggests that children with sleep disorders are significantly more likely to experience anxiety and depression [23].

Although sleeping a mean of 8–9 h in adolescents provides good sleep efficiency without daytime dysfunction and with undisturbed sleep, an intermediate chronotype, minor drowsiness, increased sleep efficiency, improved subjective sleep satisfaction, fewer sleep disorders, and less dysfunction during the day are associated with better school performance [24].

According to the results we obtained with regard to the hour of sleep, the male gender is significantly higher than the female's after 2 a.m.  $p < 0.031$ , which is partially in agreement with the research of Zhang et al. [22]. Male students find it more difficult to fall asleep in lockdown ( $2.13 \pm 1.05$ ) and suffer from more disturbed sleep at night. Similarly, researchers confirm that female adolescents reported lower sleep efficiency than male adolescents. In terms of sleep quantity, research indicates that males sleep more than females [25]. In another study, results indicate that sleep problems in young women may be related to the fact that females are at increased risk of puberty-related fatigue, sexual abuse, higher prevalence of mental illness, and susceptibility to family disruptions and increased expectations at home [26].

The new biorhythm of the daily activities of the students in lockdown regressed remarkably compared to the period before 10 a.m. compared to the old biorhythm, which was necessarily associated with the school rhythm imposing the start of classes at 8:30 a.m. during the school year. The students were more active during the schooling period, contrary to the lockdown, where they showed more sedentary behavior. One study noted that children generally obtain their daily physical activity by actively going to school, physical education and recreation, organized sports, games and dance, active play, and spending time in playgrounds and parks. Conversely, most of their sedentary time and sleep accumulates at home. Because of the COVID-19 pandemic, children's opportunities to meet movement behavior guidelines have been affected by school closures and physical removal measures implemented by many governments [27].

As a result of our research on both male and female students, gender has a significant effect on the majority of daily activities, especially in the evening, and was very significant in relation to TV and web time and highly significant in relation to physical activity times ( $\text{Chi}^2 = 20.693$ ,  $\text{df} = 5$ ,  $p = 0.001$ ) and phone calls during lockdown. Research has shown that leisure screen time and use of social media were reported to be much higher than before the COVID-19 epidemic. Parents of females in both age groups, children (5–11 years) and

youth (12–17 years), reported significantly higher use of social media [28]. This confirms the results we found.

The students in our study spent much more time in front of the screens of electronic devices, despite their studies, and received more blue light than usual. A total of 58.3% of the students spent 30 min–2 h following online courses, 46% of the students spent 1–3 h reviewing courses, 55.2% spent 2–5 h or more watching TV or using the Internet, and 55.3% spent 1–5 h or more making phone calls. Intensive television viewing by children may indicate the presence of problems such as depression, anxiety, and violent behavior, and has a negative influence on children's perception of society [29]. One piece of evidence of the impact of television exposure on school outcomes comes from a prospective birth cohort study, which found that the likelihood of obtaining a bachelor's degree (or higher) at age 26 decreased as the average number of hours of television per day of the week increased between ages 5 and 15. Earlier exposure (ages 5 to 11) was a better predictor of not obtaining a university degree, while later exposure (ages 13 to 15) was a better predictor of leaving school without a degree [30]. In addition, a Korean study with a sample of 26,395 participants (12,593 males and 13,802 females) in 150 middle and high schools representing adolescents across the country confirms that late use of electronic media was significantly associated with an increase in mood disorders, including depression and suicidality, either directly or indirectly through sleep duration or disturbances [31]. Inappropriate lifestyle habits, such as the use of smartphones/cell phones after lights out, have an impact on life rhythms. Irregular life rhythms can disrupt the secretion of melatonin, involved in the internal adjustments of the biological clock, and cortisol, involved in arousal [32].

There is evidence that children are less active and more sedentary, with less consistent sleep patterns, on unstructured or non-school days (i.e., when they are not physically in school) than on school days [33]. Students in our sample spent less time in physical activity, which made them more sedentary during lockdown. Our results are consistent with a Canadian study that found that families spent more time on sedentary behaviors and less time on physical activity compared to before the COVID-19 pandemic [28]. Because of this new situation, professional societies should update their guidance regarding screen time to support families who are trying to adhere to arbitrary screen time limits or who feel guilty about excessive screen time during the COVID-19 pandemic [34].

The duration of physical activity for our students differs significantly due to gender with respect to duration ranging from 30 min to 1 hour. Males were physically more active than females. According to the study by Guthold et al., the highest levels of physical inactivity in 2016 were found in women [35].

A total of 60.3% of students in this study spent 2–6 h per day in isolation in their space away from family members. Being separated from one's family for one reason or another creates mental health problems. Several studies have confirmed the impact of social isolation, particularly in children. They may present several psychological problems in the broad sense [36] because of the lockdown imposed by COVID-19. According to the Hamilton scale, a mean of  $2 \pm 1.33$  of our sample showed more sadness during the lockdown period. Children may develop feelings of sadness or insecurity [37], anger [38], and frustration or boredom [39]. Another study showed that children who were separated from their parents/guardians because of their infections or affected parents, or parents working in hospitals, are more susceptible to psychological problems. Their vulnerability to depression, stress, anxiety, avoidance behaviors, and post-traumatic stress disorder has been reported [40].

Our results show that in addition to the isolation of students from their families, they try more to contact their peers, marked by a mean of  $2.36 \pm 1.35$ , and to stay in contact with the external environment through long phone calls or the use of social networks. In the same context, Ellis et al.'s study shows that the use of social media seems to be linked to greater depression, as does more frequent virtual time with friends. It is important to keep in mind the nature of adolescents' interactions with peers and levels of social media use. For adolescents already struggling with depression and feeling stressed by the pandemic,

existing virtual connections may not provide sufficient support [41]. Our findings suggest that there is no gender difference in peer need. Nevertheless, Gualano et al. reported that being a woman, spending more time on the Internet, and avoiding activities due to peer pressure increases the likelihood of at least one mental health problem [42].

Our students had gastrointestinal symptoms and lack of appetite expressed by a mean of  $1.38 \pm 1.45$ . Furthermore, the students' mealtimes were delayed. A total of 44.4% have breakfast between 10 a.m. and noon, 54.5% have lunch between 2 and 4 p.m. and 43.2% have dinner between 10 p.m. and midnight. This time difference can be explained by an eating disorder, knowing that a mealtime is an important "zeitgeber" and any change in this parameter can decouple the central and peripheral clocks, resulting in circadian misalignment that leads to disruption of homeostasis and disorders of many metabolic functions [43].

In our study, gender had a significant effect on breakfast times. The disordered eating masculinity hypothesis suggests that internalized masculinity contributes to muscle-centered eating and exercise disorders or even muscle dysmorphic disorder [44,45]. Similarly, women who are encouraged to increasingly conform to feminine norms during this stressful time may be drawn to the ideal of thinness, leading to an increase in attitudes and behaviors related to eating disorders [46,47].

Mood homeostasis appeared to decrease during lockdown due to COVID-19 [48]. Good humor in the female gender was represented by a mean of 1.60, exceeding that of males (1.09) during lockdown. According to our results, gender therefore has a significant effect on mood changes.

A study comparing symptoms of post-traumatic stress in quarantined and non-quarantined parents and children found that mean scores for post-traumatic stress were four times higher in children who had been quarantined than in those who had not been quarantined [49]. Longer periods of quarantine were associated with poorer mental health, particularly symptoms of post-traumatic stress [50,51].

Because of the redundancy of the ubiquitous COVID-19 news stories in the media, our students showed avoidance behaviors, at  $18.46 \pm 13.36/40$  pts. A recent study showed that PTSD symptoms were reported by 7% of Wuhan residents after the COVID-19 outbreak, particularly by women. Being under 35 years of age and following COVID-19 updates for more than 3 h/d was associated with higher levels of anxiety compared to those over 35 years of age and those less exposed to COVID-19 updates [52]. A second study of undergraduate students confirms that anxiety and depression were significantly associated with news related to COVID-19 [53].

A score of  $1.78 \pm 1.50$  was noted in relation to the students' mental anxiety; they seemed more nervous during lockdown. In highly epidemic areas, rates of fear and anxiety were higher in children living there; however, areas with differences in epidemic risk were not statistically significant [2]. However, post-traumatic stress disorder is more likely to develop in women than in men after exposure to a traumatic event. Sensitivity to PTSD in women may be higher in childhood than after 15 years of age. Explanations for the gender difference may involve individual characteristics and traumatic experiences [54].

The combination of physical isolation, economic instability, fear of infection, and the stress of uncertainty about the future has had a profound impact on global mental health, making research in this area a top priority [40,55].

Students in our study had financial concerns:  $2.19 \pm 1.47$  in relation to fear of job loss and  $2.14 \pm 1.44$  in relation to fear of shrinking family and personal budgets. These results are consistent with other studies reviewed confirming that financial loss has created severe socio-economic distress [56].

Regarding the fear of getting sick, our students scored  $2.47 \pm 1.40$ , which explains their strong fear of being infected with COVID-19. Participants in some studies have reported fear about their own health or fear of infecting others [51,57,58]. Other researchers indicate that students who worry more about family and friends are more likely to become more

depressed and stressed. Worries about one's future career contributed to higher levels of anxiety and stress [59].

The present study had some limitations that seem to be mentioned. Due to the lack of a validated tool to measure the circadian rhythm of the students' daily activities, it was necessary to design a questionnaire for the collection of the data essential for our research. This could be a disadvantage and may modify some results. In the lockdown, it was not possible to carry out the tests in person. As a result, the students' answers could be biased due to the absence of instant feedback in the face of misunderstandings or misinterpretations of questions. Furthermore, due to the ongoing health crisis, including conditional deconfinement in the Kingdom of Morocco, the circadian rhythm of students' daily activities is still restricted, which will impact the validity of the results obtained in the event of a similar study.

## 5. Conclusions and Perspectives

Our study highlights the impact of the pandemic on the lives of students according to their gender and their psychological health, which has been sidelined. All circadian parameters were questioned, from sleep, physical activity, eating rhythm and many other variables whose imbalance has damaged the mental health of our sample and increased their post-traumatic stress. As a result, the students' performance was somewhat disrupted as their attention was dispersed because of the news related to COVID-19. This study focused on a category that requires special attention due to the sensitivity it demonstrated in the face of this traumatic event. Adolescents today are subject to the interaction of a multitude of factors in their surrounding environment, knowing that the slightest disorder could interfere with the rhythm of their daily life which will negatively affect their performance at the psychological, academic, psychomotor and emotional levels. The COVID-19 pandemic was indeed the biggest unexpected event that had to be managed, except that its impact on the economy and social life of nations exceeded the governments' forecasts, which dragged their attention away from children and adolescents, the categories most affected by the consequences of this pandemic. As our study shows, the times of student activity have changed compared to when they were in school. Before lockdown, the day started at 8 a.m., while during lockdown, it was only after 10 a.m. that 24.2% of students started their daily activities. As a result, adolescents' sleep was disordered during lockdown. Males generally tended to sleep and wake up later, showed more difficulty falling asleep, and had more physical fatigue and isolation than females, while the latter were more early risers and had good humor. These mood states affect the eating patterns of both genders, especially at breakfast when females generally ate between 8 a.m. and 10 a.m. while males ate after 12 p.m. In terms of academic study and physical activity, males were more engaged compared to females who spent more time watching TV or using the web during the day, while males were more active using blue screens after midnight. As the effects of the pandemic continue to affect the mental health of the sample, post-traumatic stress increased in the various parameters that affect the well-being of students in their entirety. Half of the sample showed sadness and psychic anxiety, had lost interest in schoolwork and suffered from slowness of actions and thoughts during lockdown due to traumatic information overload, which half of the sample avoided. Because of what the students experienced, they suffered from a lack of appetite, mainly among females, as they developed a sense of guilt and a perception of the pandemic as a punishment (knowing that Tangney and Dearing associated guilt with state anxiety [60]). In lockdown, the students had many concerns. They expressed concern about understanding courses, exams at the end of the year, planning for remediation, and the extension of studies in July. They also expressed concern about shrinking family and personal budgets and reduced employment, as well as fear of contamination at school or falling ill, which explains their concern about returning to school. These fears remarkably reflected the psychological state of the students, expressing uneasiness about the rhythm of their lives and the impact that the coronavirus could have on their health, which led to a deterioration in their post-traumatic stress and mood states.

Following the results of the present study, the students in our sample had problems with their psychological states, areas of concern, mood states and post-traumatic stress caused by COVID-19 and its impact on social life on the one hand, and the inattention of the Moroccan authorities regarding this category in the face of other problems that they considered a priority on the other. In order to reduce the damage suffered by these students, we propose to create remote psychological support units via platforms particularly dedicated to depressed, worried and/or stressed young people. These units can also be implemented in schools in order to provide support and guidance services, sometimes requiring the intervention of specialists. Nevertheless, this study needs to include larger samples in different Moroccan cities to analyze and infer the extent to which the pandemic has impacted young people. It should be noted that an anticipatory view of the facts of the pandemic is necessary to avoid psychological complications that could threaten the stability of social lives in the country in the future.

In addition, we propose to:

- Extend the study to correlate gender with circadian rhythms of daily activities and psychological conditions in relation to levels of schooling, especially certificate classes.
- To set up a project to validate an instrument to measure the circadian rhythms of daily activities of students.

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