Long term effects and the mediating role of coping styles between behavioral changes and psychopathological responses among Polish university students during the COVID-19 pandemic

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Summary

Aim. Students have been indicated as an at-risk group for developing poorer psychological responses and decreased well-being during the COVID-19 pandemic. The aim of the study was to observe a trajectory of lifestyle changes and its impact on mental health in longitudinal perspective as well as explore the coping strategies used by students during the pandemic and their possible mediating effect on psychopathological symptoms.

Material and methods. Data were collected via an online survey addressing behavioral changes that occur during the pandemic, as well as psychopathological and PTSD symptoms. It was conducted among university students at two time-points May and June 2020 as well as June and October 2021 with a pooled total number of participants n = 2,010.

Results. the studied population of Polish university students has experienced significant behavioral and psychological changes due to the COVID-19 pandemic which remained influential after over a year into the crisis.

Conclusions. All of the variables associated with worse mental health in the beginning of the pandemic remained significantly related to higher psychopathology and PTSD symptoms over a year later. Partial mediations were observed between all of the explored coping strategies, behavioral changes and psychopathological symptoms.

Key words: COVID-19, coping styles, psychopathology.

Introduction

Ever since the COVID-19 outbreak in late 2019, studies have been conducted on population's mental health revealing growing evidence on its deterioration due to the pandemic's immediate and direct as well as indirect consequences [1]. Many researchers reported anxiety, depression, sleep deprivation, and negative changes in daily routines, to name just a few [1, 2]. What is important, the COVID-19-related confinement led to many negative consequences among individuals as well as specific groups.

Students have been indicated as one of the groups that manifested a tremendous prevalence of psychiatric symptoms and lifestyle changes that led to poorer psychological well-being response to the observed changes [3–6]. In Australian research, 68% of students reported worsened mental health due to COVID-19-related confinement [7]. Likewise, a Polish study reported psychiatric symptoms and poorer psychological well-being in over 78% of researched university students at the time of a prolonged online learning period brought forth by the pandemic [8]. Among the most manifested psychiatric symptoms studies listed: anxiety, depression and insomnia. Abrupt lifestyle changes have proven to largely contribute to their occurrence. Those changes were often associated with abandonment of the pre-COVID daily routine [9, 10], a decrease in physical activity [11, 12], an increase in sedentary behaviors [11, 13], job-related worries and employment status [13], worsened eating behaviors [14, 15], giving-up a sleeping schedule [14], and loss or decrease of social relationships resulting from strained social distancing [16]. Those effects on university students have been reported irrespective of country or the stage of education [16]. The prolonged pandemic and the possible recurrence of restrictions required a long-term adaptation in the student population, who were forced to adapt to changes resulting from COVID-19 restrictions and worried about their future [17]. In a US study it has been reported that students are anxious about an array of concerns, including delayed graduations, possible job loss or difficulties to find one and that they expect to earn less by the time they turn 35 in comparison to their peers who had graduated before the COVID-19 pandemic [18].

Furthermore, if previous studies did not sufficiently call for attention in terms of need for psychosocial interventions among university students in order to confine the negative effects of COVID-19-related stress and lifestyle changes, further threats must be considered. A meta-analysis on severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS) by Rogers et al. (2020) [19] showed that psychiatric symptoms often develop or manifest themselves at the post-illness stage following acute infection. Those results concerned symptoms of post-traumatic stress disorder, anxiety and depression with 32.2%, 14.9% and 14.8% symptom rate respectively, after surviving the illness and/or confinement related to it. Consequently, the possibility and rate of delayed as well as prolonged negative psychological responses among university students in times of COVID-19 must be examined.

So far, few longitudinal studies on university students' mental health changes during COVID-19 pandemic have been conducted around the world. Those carried out reported evident increase in anxiety and depressive symptoms among university students in China [3], India [6] and the United States [18, 19].

Coping is a term that can be briefly described as "the ongoing behavioral, cognitive and emotional process of managing stress and the negative effects – biological, psychological, and social – it can have on people's lives" [20, p. 596]. Specific coping strategies include a variety of behaviors people employ in reaction to a perceived stressor in order to meet the demands of the situation (e.g., problem solving, cognitive restructuring, venting, distraction, avoidance, wishful thinking, seeking social support, denial, substance use, etc.). In literature those specific coping strategies are typically grouped into problem-focused strategies, action-oriented strategies and emotion – as well as avoidance-based strategies [20], where the latter are typically considered less beneficial and associated with various negative outcomes, such as higher stress anxiety and depression [21]. Problem-oriented, active coping strategies on the other hand have been linked to quality of life and psychological well-being [22]. Coping strategies have also been the subject of research addressing the impact of the COVID-19 pandemic on psychological variables, identifying correlations between the preferred coping style and levels of psychopathological and PTSD symptoms [24], as well as pointing towards a beneficial effect of problem-focused coping on lowering pandemic-related stress [24].

The aim of our study was to follow-up the results obtained in our previous cross-sectional study of and to measure the persistence of mental health problems related to lifestyle changes among university students in Poland, as well as to observe a trajectory of lifestyle changes and its impact on mental health in longitudinal perspective. Another objective of the study was to explore the coping strategies used by students during the pandemic and their possible mediating effect on the experienced psychopathological symptoms.

1. Materials and methods

1.1. Study design

The cross-sectional observational study was conducted via Computer Assisted Web Interviewing (CAWI) in two waves of the pandemic – May and June 2020 as well as June and October 2021. The online survey was distributed among university students in Poland, with the use of social media, university websites and institutional help. All students who declared they were actively involved in a masters, bachelor's or PhD program at the time of data collection were eligible. All of the collected data was anonymous and informed consent was obtained from all participants. The first data collected between May and June 2020 (group A) were analyzed and some of the results were previously published, hence they are not included in the results section of this paper. The second data collection with the use of the same measure-

ments was conducted over a year later – between June and October 2021 (group B, *n* = 995) – aimed at the same group and with the use of the same distribution channels. However, while it did not directly address the same students, it cannot be considered as follow-up.

The first part of the analysis focuses on reporting new data regarding pandemic-related behavioral changes and psychopathological symptoms among the participants from group A and B. The second part of the study includes an analysis of coping strategies employed by this population and their influence on behavioral changes as well as psychopathological symptoms and uses pooled data from both groups (A and B, *n* = 2,010) at both timepoints. At both data collection points, to address the possibility of adverse emotional reactions to triggering subject matter in the survey and/or general negative emotional responses due to the prolonging COVID-19 crisis the participants were offered an opportunity to receive free psychological counselling, following participation. The study was conducted according to the guidelines of the Declaration of Helsinki, and the study protocol was approved by the Ethics Committee at the Wroclaw Medical University in Poland (no. 309/2020).

1.2. Participants

The studied group included 995 participants. 553 were female (55.58%) and 442 were male (44.42%). The mean age in the study group was 22.54 ± 3.35 years and all of the respondents were university students, mostly distributed between 1st and 2nd year (*n* = 417; 42.86%), as well as 3rd or 4th year (*n* = 411; 42.24%), the remaining 14.9% were either 5th, 6th year or PhD students. A detailed description of the demographic characteristics of the group can be found in Table 1.

Table 1. **Demographic characteristics of the study sample (n = 995)**

DEMOGRAPHIC			COVID-19		
Sex	*n*	%		*n*	%
Male	442	44.42	**Infected**		
Female	553	55.58	Yes	157	15.78
Age	Mean 22.54, SD (3.35), median 22.00 (21.00, 23.00)		No	838	84.22
Place of residence			**Quarantined**		
<100 thousand	407	40.90	No	796	80.81
>100 thousand	588	59.10	Yes	189	19.19
Employment			Unknown	10	
Unemployed	543	54.57	**Quarantined family member**		

table continued on the next page

Employed	452	45.43	Yes	84	8.44
Source of income			No	911	91.56
Partner	20	2.01	**Death in family**		
Family	700	70.35	No	850	85.43
Self-supportive	275	27.64	Yes	145	14.57
EDUCATION					
Field of study			**Year**		
Medical	63	6.33	1st & 2nd	417	42.86
Technical	378	37.99	3rd or 4th	411	42.24
Other	554	55.68	5th or 6th	145	14.9
Full-/part-time			Other	22	
Full-time	887	89.15			
Part-time	108	10.85			

1.3. Measures

The entire online survey consisted of three sections:

(1) Demographic data (see: Table 1).
(2) Data on behavioral changes that resulted from the pandemic were collected with the help of a questionnaire specifically designed for this study. The questionnaire was previously tested (data collection in group A) and achieved a satisfactory Cronbach's alpha of α = 0.701. The items referred to previously established risk factors (e.g., an ability to maintain an everyday routine despite the circumstances, a decrease in physical activity, changes in relationships, eating habits, increased substance use, etc.). Sample items in this section included: *"Were your able to keep your everyday routine during the pandemic?"*, "During the pandemic, have you noticed you neglect your [hygiene, meals, interests] more than usual?", "Has the average time you spend on [sleep/physical activity] changed during the pandemic?".
(3) Psychometric instruments to assess the level of psychopathological symptoms (*General Health Questionnaire*, GHQ-28) and post-traumatic stress (*Impact of Events Scale Revised*, IES-R). Cronbach's alpha for this section was GHQ-28 α = 0.96; IES-R α = 0.86.
   – *The General Health Questionnaire* (GHQ-28) [25] consists of 28-items and 4 subscales: "Somatic symptoms", "Anxiety and insomnia", "Social dysfunction", and "Severe depression". The items are rated on a 4-point

Likert scale, from 0 ("not at all") to 3 ("much more than usual"). The maximum score is 84 and higher scores are considered indicative of higher levels of psychopathology. In this study, the cut-off score for psychological distress was above 24 points.

– *The Impact of Events Scale Revised* (IES-R) [26] consists of 22 items rated on a 5-point Likert scale. It is designed to assess the perceived level of stress experienced in the context of a specific traumatic event. The questionnaire addresses 3 dimensions diagnostically associated with post-traumatic stress disorder (PTSD) symptoms: intrusions, arousal and avoidance. In this study, the cut-off score for PTSD symptoms was above 26 points, which indicates a moderate or severe impact of the event.

– *The Coping Orientation to Problems Experienced Inventory* (Brief-COPE) [27] is a self-administered questionnaire consisting of 28 items. The items refer to the typical reactions presented by the respondent in response to a stressful situation. The answers are then grouped into strategies and indicate the dominant coping strategy (or strategies) in dealing with stressful events.

1.4. Data analysis

Descriptive statistics (mean, standard deviation, median, and quartiles or counts and percentages) were used to calculate variables (demographic and clinical) and GHQ and IES-R scores. Differences in GHQ or IES-R between questionnaire responses were assessed using the Mann–Whitney test and Kruskal–Wallis test with the Holm correction for multiple comparisons. Additionally, effect sizes r (for Mann–Whitney test) or eta squared (for Kruskal Wallis) were reported. The relationship between high psychological distress score and questionnaire responses was performed using χ^2 test for independence. Mediation analysis of GHQ, IES-R scores and coping strategies was performed using structural equation modeling. All analyses were performed in R for Windows, version 4.3.1 (R Foundation for Statistical Computing, Vienna, Austria). Mediation was performed using Lavaan package [28]. $P < 0.05$ was selected as the significance threshold.

2. Results

2.1. Correlations between psychopathological (GHQ-28) and PTSD (IES-R) symptoms and behavioral changes that occurred during the pandemic ($n = 995$)

All of the questionnaire items relating to the pandemic-induced behavioral changes were significantly correlated with psychopathological as well as PTSD symptoms. The respondents who declared they were unable to maintain their everyday routine during the pandemic experienced significantly higher psychopathological symptoms

than those who were able to maintain it ($M = 38.43$; $SD = 18.52$; $p < 0.001$, moderate effect size). They were also the majority of the sample (50.45%). In this group 74% of respondents also scored above cut-off score for psychological distress (χ^2, $p < 0.001$). As this was the only questionnaire item phrased positively – a "yes" answer was favorable in terms of mental health. For the remaining items "yes" was indicative of the onset of a maladaptive behavior and therefore significantly correlated with higher GHQ scores. Behaviors which were related to significantly higher psychopathological symptoms included: an increase in alcohol and tobacco consumption, end or deterioration in partner relationships, the onset of sexual dysfunctions, changes in food intake or sleeping patterns as well as a decrease in physical activity. The observed effect sizes were considered small. Among the students who increased alcohol and tobacco consumption, experienced an end or deterioration in their relationship with their partner or the onset of a sexual dysfunction, more than 80% also scored above cut-off score for psychopathological distress (80%, 83%, 80% and 83% respectively). The behavioral changes that were most common in the studied group concerned changes in food intake (66.13%), changes in sleeping patterns (68.84%) as well as a decrease in physical activity (57.49%). For detailed results see Table 2.

A similar trend was noticeable for the IES-R scores, where the choice of a maladaptive behavior and/or a negative change also significantly correlated with increased PTSD symptoms, with small effect sizes, for all of the questionnaire domains. Interestingly, although GHQ and IES-R scores varied between respondents who declared different behavioral changes, the mean scores for the entire study group were still above the cut-off score for psychological distress (lowest mean GHQ score = 25.42; χ^2, $p < 0.001$, lowest mean IES-R score = 26.16). For detailed results see Table 2.

2.2. Correlations between coping strategies and behavioral changes that occurred during the pandemic for group A (data collection from May to June 2020, $n = 1,015$) and B (data collection from June to October 2021, $n = 995$)

At the first data collection point respondents from group A who were able to maintain an everyday routine, more often used strategies such as: active coping, planning and positive reframing ($m = 1.96$, 1.98, 1.40, respectively) than strategies such as seeking instrumental support, behavioral disengagement and self-blame ($m = 1.77$, 0.44, 0.78, 1.67, respectively). The same was true for respondents from group B, with the exception of seeking instrumental support which was not significant for group B and substance use, which was in turn not significant for group A.

The only other behaviors linked to active coping strategies were an increase in alcohol and tobacco consumption. The respondents from group A who reported an increase in alcohol consumption also scored lower on active coping. In group B, active coping and planning were among the strategies most often chosen by both groups: the one who did as well as those who did not increase tobacco use, with a higher prevalence in the group who did not increase smoking.

Emotion-focused coping strategies, such as seeking emotional or instrumental support, were exclusively significant in group A and reported more often by respondent who have not experienced any adverse changes in their relationship with their loved one as well as those who did not decrease their physical activity.

The only two coping strategies that were significantly related to all of the behavioral changes were substance use and self-blame in group B, where both were chosen more often by respondents who also reported the inability to maintain an everyday routine, an increase in alcohol and tobacco consumption, a negative change in their partner relationship, the onset of sexual dysfunctions, a change in food intake, sleeping patterns, and a decrease in physical activity. Among the coping strategies with a significant relationship to behavioral changes during the pandemic avoidance-based strategies, such as denial, venting and behavioral disengagement were also used more often in the aforementioned group. Detailed results are presented in Table 3.

Table 2. **Differences in GHQ-28 and IES-R scores between groups based on their questionnaire responses (n = 995)**

Questionnaire item	Response	n, (% of n=995)	GHQ			GHQ 24 cut-off point				IES-R	
			Mean (SD)	Effect size1, p²		<24	>24	χ²	p²	Mean (SD)	Effect size¹, p²
Ability to maintain everyday routine	No	502 (50.45%)	38.43 (18.52)	0.3284***(M)		25%	75%		***	38.03(19.47)	0.2087***(S)
	Yes	493 (49.55%)	26.53 (17.19)			53%	47%			29.49 (19.07)	
Increase in alcohol consumption, compared to pre-pandemic	No	790 (79.4%)	30.00 (17.69)	0.24776***(S)		44%	56%		***	31.62 (20.04)	0.20298***(S)
	Yes	205 (20.60%)	42.31 (19.90)			20%	80%			42.19 (20.30)	
Increase in tobacco consumption, compared to pre-pandemic	No	845 (84.2%)	30.18 (17.61)	0.27344***(S)		43%	57%		***	31.73 (20.21)	0.2353***(S)
	Yes	150 (15.8%)	45.83 (20.00)			17%	83%			45.46 (18.41)	
Relationship with partner deteriorated or ended	No	825 (82.91%)	30.65 (18.23)	0.21444***(S)		43%	57%		***	32.13 (20.36)	0.17688***(S)
	Yes	170 (17.09%)	41.69 (19.07)			20%	80%			41.88 (19.48)	
Onset of sexual dysfunctions	No	914 (91.86%)	31.23 (18.20)	0.21173***(S)		41%	59%		***	32.91 (20.39)	0.14684***(S)
	Yes	81 (8.14%)	47.2 (19.68)			16%	84%			43.77 (19.63)	
Change in food intake, compared to pre-pandemic	No	337 (33.87%)	25.77 (16.76)	0.26769*** (S)		54%	46%		***	27.72 (19.97)	0.21074***(S)
	Yes	658 (66.13%)	36.00 (18.90)			31%	69%			36.91 (20.13)	
Change in sleeping patterns, compared to pre-pandemic	No	310 (31.16%)	25.42 (16.27)	0.25798***(S)		54%	46%		***	26.16 (19.55)	0.248***(S)
	Yes	685 (68.84%)	35.76 (19.03)			32%	68%			37.25 (20.05)	
Decrease in physical activity, compared to pre-pandemic	No	423 (42.51%)	26.26 (16.80)	0.29587***(S)		53%	47%		***	29.99 (20.14)	0.15843***(S)
	Yes	572 (57.49%)	37.17 (18.92)			29%	71%			36.61 (20.39)	

¹ Effect size S – small, M – medium, L – large

² *P*-value: <0.05*, <0.01**, <0.001***

Table 3. Correlations between coping strategies and behavioral changes that occurred during the pandemic; group A data collection May/June 2020 (n = 1,015) and B data collection June/October 2021 (n = 995)

Mini CopeScale	Group	Ability to maintain everyday routine[1]		Increase in alcohol consumption, compared to pre-pandemic		Increase in tobacco consumption, compared to pre-pandemic		Relationship with partner deteriorated or ended		Onset of sexual dysfunctions		Change in food intake, compared to pre-pandemic		Change in sleeping patterns, compared to pre-pandemic		Decrease in physical activity, compared to pre-pandemic	
		No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Active Coping	A	1.73 (0.68)	1.96 (0.69)***[2]	1.84 (0.69)	1.63 (0.67)**												
	B	1.76 (0.77)	1.99 (0.72)***[2]			1.91 (0.74)	1.69 (0.80)*										
Planning	A	1.74 (0.73)	1.98 (0.74)***														
	B	1.78 (0.77)	1.94 (0.77)**			1.90 (0.75)	1.64 (0.83)**										
Positive Reframing	A	1.21 (0.83)	1.40 (0.84)**														
	B	1.18 (0.85)	1.38 (0.87)**														
Acceptance	A																
	B											1.82 (0.73)	1.61 (0.77)**				
Humor	ns[3]																
Religion	ns																
Seeking emotional support	A							1.68 (0.87)	1.42 (0.90)**								
	B																

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Coping style	Group																
Seeking instrumental support	A	1.56 (0.90)						1.67 (0.89)								1.73 (0.9)	
	B	1.77 (0.89)*						1.41 (0.92)**								1.55 (0.9)*	
Self-distraction	ns																
Denial	A			0.69 (0.72)						0.55 (0.66)				0.45 (0.58)			
	B			0.56 (0.69)	0.84 (0.76)***					0.46 (0.61)	0.67 (0.75)**				0.67 (0.75)***		
Venting	A																
	B					1.20 (0.75)	1.43 (0.75)***										
Substance use	A	0.5 (0.76)	1.41 (0.93)***					0.50 (0.80)	0.91 (1.03)***	0.63 (0.84)	1.12 (1.11)**						
	B	0.39 (0.69)	1.28 (1.05)***					0.50 (0.80)	0.91 (1.03)***	0.53 (0.82)	1.07 (1.10)***	0.42 (0.69)	0.65 (0.92)**	0.36 (0.7)	0.67 (0.9)***	0.46 (0.78)	0.66 (0.90)***
Behavioral disengagement	A	0.99 (0.77)	0.78 (0.73)***									0.76 (0.68)	0.97 (0.78)**				
	B					0.77 (0.75)	1.09 (0.83)***			0.78 (0.75)	1.22 (0.87)***	0.68 (0.71)	0.89 (0.79)***	0.70 (0.73)	0.87 (0.78)*	0.68 (0.74)	0.92 (0.78)***
Self-blame	A	1.92 (0.87)						1.62 (0.97)	1.91 (0.89)**	1.64 (0.88)	1.90 (0.87)**	1.66 (0.91)	1.89 (0.86)*				
	B	1.87 (0.91)	1.46 (0.98)***	1.61 (0.95)	1.88 (0.99)**	1.61 (0.96)	2.00 (0.93)***	1.62 (0.97)	1.91 (0.89)**	1.62 (0.96)	2.21 (0.81)***	1.42 (0.95)	1.79 (0.95)***	1.42 (0.94)	1.78 (0.96)***	1.48 (0.97)	1.81 (0.94)***

[1] M (SD); [2] P-value: <0.05*, <0.01**, <0.001***; [3] ns = not statistically significant

2.3. Linear regression – mediation models for the relationships between coping strategies, behavioral changes that occurred during the pandemic and psychopathological symptoms (GHQ) ($n = 2,010$)

Based on the findings pertaining to the relationships between behavioral changes and coping strategies during the pandemic, a linear regression analysis was performed taking into account three variables: coping style, psychopathological symptoms and behavioral change. In this way we explored the possible role of coping styles as a mediator between behavioral choices/changes and the level of psychopathological symptoms. Based on the previous literature [29, 30] as well as the findings in section 2.2. of this paper, the Brief-COPE subscales were pooled into three main coping styles: active coping (AC), avoidance coping (AV) and emotion-oriented coping (EC) (see: Fig. 1). In this analysis data from both time points (group A and B) was also pooled together to allow for a larger sample, which effectively resulted in $n = 2,010$ observations included in the statistical analysis.
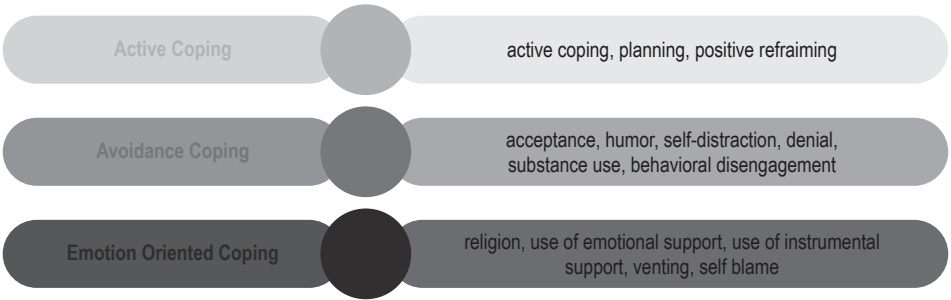
Figure 1. **Brief-COPE subscales include in 3 major coping styles: active, avoidant and emotion-oriented coping**

The results of the linear regression analysis for the ability to maintain an everyday routine as the independent variable, GHQ scores as the dependent variable and coping styles as the potential mediator revealed significant associations between all of the variables, regardless of the preferred coping style. Thus, the ability to maintain an everyday routine was negatively associated with the GHQ scores (C-path), and positively associated with the coping style (A-path) for AC, AV as well as EC (C = – 0.535, – 0.376, – 0.647, respectively; p <0.001; A = 0.227, 0.071, 0.015, respectively; p <0.001). The association between AC, AV as well as EC coping styles and GHQ scores for the ability to maintain an everyday routine (B-path) was always negative (B = – 0.551, – 4.011, – 0.812, respectively; p <0.001), suggesting the use of any given coping style reduced GHQ scores. Detailed results can be found in Table 4. In the mediation model a partial negative mediation of AC and AV was revealed with an indirect effect of – 0.125 and – 0.283, respectively (p >0.001). The mediation along with the regression analysis was presented on Figure 2. Detailed results can be found in Table 5.
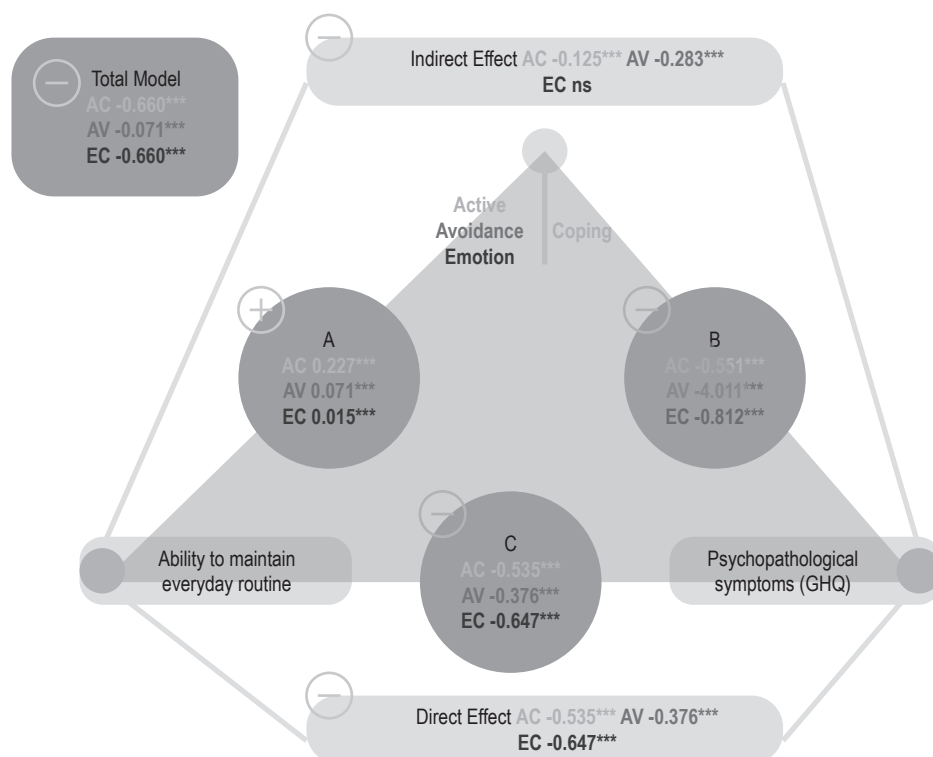
Figure 2. **Partial mediation of AC and AV coping strategies between the ability to maintain an everyday routine and GHQ scores (n = 2,010)**

The remaining questionnaire items demonstrated directly opposite associations, in which those behavioral changes that were statistically significant were positively associated with GHQ scores (C), and negatively associated with the coping style (A) for AC, AV as well as EC. The association between coping style and GHQ scores for the remaining questionnaire items was always negative. All of the regressions for AC and most for AV were statistically significant, the least significant results were obtained for the A path for EC. Detailed results can be found in Table 4. A partial positive mediation of AC, AV and EC was found for the changes of behavior during the pandemic and GHQ with an indirect effect ranging between 0.065–0.164 for AC, 0.193–0.587 for AV (strongest) and 0.019–0.024 (weakest) for EC, p <0.001. The mediation along with the regression analysis is presented in Figure 5. Detailed results can be found in Table 5.
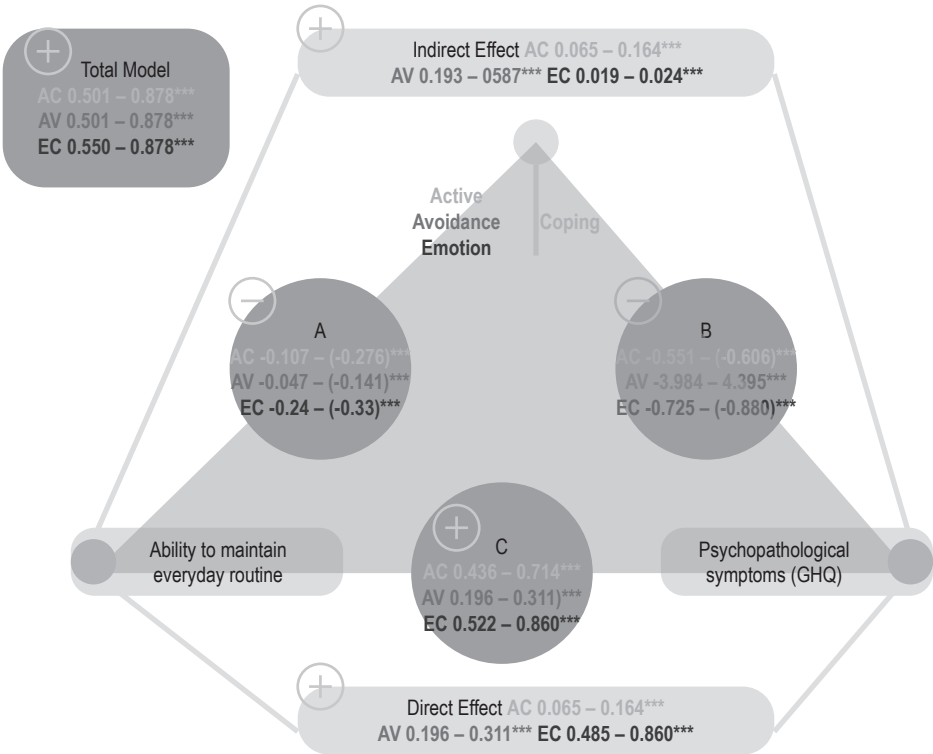
Figure 3. **Partial mediation of AC, AV and EC coping strategies between the remaining behavioral changes during the pandemic and GHQ scores (n = 2,010)**

Table 4. Linear regression analysis: coping strategies, behavioral changes that occurred during the pandemic and psychopathological symptoms (GHQ) (n = 2,010)

| Questionnaire item	ACTIVE COPING (AC)			AVOIDANCE COPING (AV)			EMOTIONAL COPING (EC)		
	GHQ (C)[1]	AC (A)[1]	GHQ X AC (B)[1]	GHQ (C)	AV (A)	GHQ X AV (B)	GHQ (C)	EC (A)	GHQ X EC (B)
Ability to maintain everyday routine	-0.535***[2]	0.227***	-0.551***	-0.376***	0.071***	-4.011***	-0.647***	0.015***	-0.812***
Increase in alcohol consumption, compared to pre-pandemic	0.464***	-0.135***	-0.604***	0.008	-0.124***	-4.326***	0.522***	-0.029***	-0.808***
Increase in tobacco consumption, compared to pre-pandemic	0.490***	-0.152***	-0.607***	0.116	-0.106***	-4.395***	0.566***	-0.019	-0.854***
Relationship with partner deteriorated or ended	0.480***	-0.117***	-0.599***	0.293***	-0.065***	-3.984***	0.527***	-0.033***	-0.725***
Onset of sexual dysfunctions	0.714***	-0.276***	-0.594***	0.291***	-0.141***	-4.156***	0.860***	-0.022	-0.857***
Change in food intake, compared to pre-pandemic	0.476***	-0.167***	-0.574***	0.233***	-0.082***	-4.126***	0.562***	-0.011	-0.832***
Change in sleeping patterns, compared to pre-pandemic	0.436***	-0.107***	-0.606***	0.196***	-0.073***	-4.153***	0.495***	-0.006	-0.880***
Decrease in physical activity, compared to pre-pandemic	0.439***	-0.108***	-0.599***	0.311***	-0.047***	-4.122***	0.485***	-0.024***	-0.797***

[1] C – direct effect between independent and dependent variable (behavioral change regressed on GHQ total score); A – (indirect effect) behavioral change regressed on coping style; B – (indirect effect) coping style regressed on GHQ total score.

[2] P-value: <0.05*, <0.01**, <0.001***

Table 5. **Mediation model: coping strategies, behavioral changes that occurred during the pandemic and psychopathological symptoms (GHQ) (n = 2,010)**

Questionnaire item	ACTIVE COPING and GHQ			AVOIDANCE COPING and GHQ			EMOTIONAL COPING and GHQ		
	Indirect effect[1]	Direct effect[2]	Total[3]	Indirect effect	Direct effect	Total	Indirect effect	Direct effect	Total
Ability to maintain everyday routine	-0.125***[4]	-0.535 ***	-0.660***	-0.283***	-0.376***	-0.660***	-0.012	-0.647 ***	-0.660***
Increase in alcohol consumption, compared to pre-pandemic	0.081***	0.464***	0.545***	0.537***	0.008	0.545 ***	0.024***	0.522***	0.545***
Increase in tobacco consumption, compared to pre-pandemic	0.092***	0.490***	0.582***	0.466***	0.116	0.582 ***	0.017	0.566***	0.582***
Relationship with partner deteriorated or ended	0.070***	0.480***	0.550***	0.258 ***	0.293***	0.550***	0.024***	0.527***	0.550***
Onset of sexual dysfunctions	0.164***	0.714***	0.878***	0.587***	0.291***	0.878***	0.019	0.860***	0.878***
Change in food intake, compared to pre-pandemic	0.096***	0.476***	0.572***	0.339***	0.233***	0.572***	0.009	0.562***	0.572***
Change in sleeping patterns, compared to pre-pandemic	0.065***	0.436***	0.501***	0.305***	0.196***	0.501***	0.006	0.495***	0.501***
Decrease in physical activity, compared to pre-pandemic	0.065***	0.439***	0.503***	0.193***	0.311***	0.503***	0.019***	0.485***	0.503***

[1] Indirect effect for mediation model: coping style mediation between behavioral change and GHQ total score; [2] Direct effect between independent and dependent variable (behavioral change regressed on GHQ total score); [3] Total effect for mediation model.

[4] P-value: <0.05*, <0.01**, <0.001***

2.4. Multiple linear regression – mediation models for the relationships between coping strategies, behavioral changes that occurred during the pandemic and PTSD symptoms (IES-R) ($n = 2{,}010$)

Another multiple linear regression including all of the behavioral changes during the pandemic as independent variables and PTSD symptoms as dependent variables was conducted to explore the role of coping styles in mediating the relationship between these variables. As opposed to the previous section, in this analysis different coping styles did yield different results. Although in the AC model behavioral changes during the pandemic directly positively influenced GHQ scores (direct effect: 31.798; $p < 0.001$), no mediation could be established for AC between behavioral changes and IES-R scores (indirect effect insignificant). For AV there was exclusively a significant indirect effect (31.932; $p < 0.001$), indicating behavioral changes during the pandemic did not influence IES-R scores directly but only through the mediator. A partial negative mediation was also found for EC (indirect effect – 0.693; $p > 0.05$). Detailed results can be found in Table 6. The mediation model was presented on Figure 4.
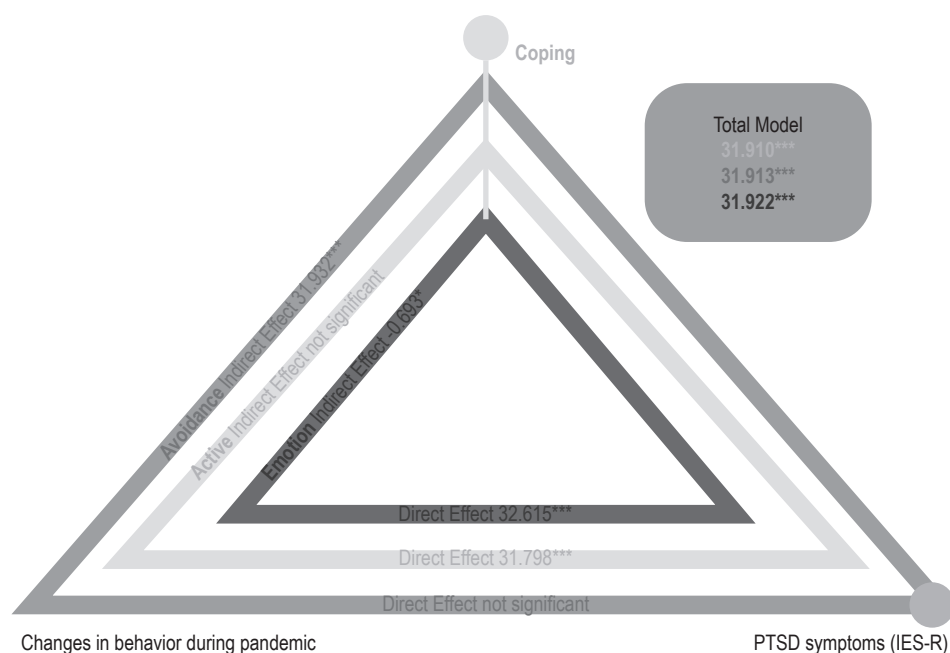
Figure 4. **Mediation model of AC, AV and EC coping strategies between behavioral changes during the pandemic and IES-R scores (n = 2,010)**

Table 6. **Mediation model: coping strategies, behavioral changes that occurred during the pandemic and PTSD symptoms IES-R) (n = 2,010)**

	ACTIVE COPING and IES-R			AVOIDANCE COPING and IES-R			EMOTIONAL COPING and IES-R		
	Indirect effect[1]	*Direct effect*[2]	*Total*[3]	*Indirec teffect*	*Direct effect*	*Total*	*Indirect effect*	*Direct effect*	*Total*
Independent variable (behavioral changes)	0.112	31.798***	31.910***	31.932***	-0.019	31.913***	-0.693*	32.615***	31.922***

[1] Indirect effect for mediation model: coping style mediation between behavioral change and GHQ total score;

[2] Direct effect between independent and dependent variable (behavioral change regressed on GHQ total score);

[3] Total effect for mediation model; [4] *P*-value:<0.05*, <0.01**, <0.001***

3. Discussion

The presented results suggest the studied population of Polish university students has experienced significant behavioral and psychological changes due to the COVID-19 pandemic which remained influential after over a year into the crisis. In comparison to our previous study, which was conducted over a year earlier and much at the start of the pandemic, the overall picture of the studied population did not change much [23]. Over half of the studied population still struggled with maintaining a daily routine, which in turn impacted their mental health (in terms of GHQ as well as IES-R scores). The behavioral changes that were most common in the studied group concerned changes in food intake (66.13%), changes in sleeping patterns (68.84%) as well as a decrease in physical activity (57.49%). At the first data collection point, however, only approximately a third of the students were able to maintain a daily routine, whereas after the year every other participant provided positive answer, suggesting some improvement in this area with increasing duration of the pandemic.

Previously drawn conclusions regarding risk factors were confirmed – all of the variables associated with worse mental health in the first study (alcohol and tobacco consumption, deterioration of relationship, onset of sexual dysfunctions, changes in food intake as well as sleep and physical activity) remained significantly related to higher GHQ and IES-R scores over a year later. An interesting result obtained at this data collection point was that the GHQ-28 mean scores for the entire studied group remained above cut-off for psychological distress. Although this was also true at the first data collection point, published elsewhere [23], this result went unnoticed at the time. Interestingly, the sole numerical values of the means at both data collection points suggest a general decrease in GHQ as well as IES-R scores across questionnaire responses with longer duration of the pandemic. Based on our results, it stands to reason the impact of the pandemic on students' mental health did not significantly

change in quality, but it possibly demonstrates a tendency to lessen in quantity over time, suggesting some form of habituation to the stress factor. This finding confirms the results of the study by Silveira et al. [31], in which general psychological vulnerability was shown to increase after the emergence of COVID-19 pandemic and partially decrease with time, possibly due to the less rigorous social restrictions in following pandemic waves.

Compared to previous observational studies and results of a meta-analysis conducted on various populations, we observed a prolonged occurrence of psychopathological symptoms in the population of students [32, 33]. This finding may be related to the sustained changes to the daily life of students such as distant learning and consequential social isolation [35]. Additionally, a more sedentary behavior with decreased levels of physical activity has also been demonstrated in population of students, both factors also associated with worse mental health outcomes, such as loneliness, stress and depressive symptoms in the general population [35, 36].

The results related to the correlations between coping strategies and behavioral changes that occurred during the pandemic for group A and B showed, that not all of the individual coping strategies measured by the Brief-COPE inventory were significantly related to behavioral changes during the pandemic. Some of the strategies were used more often than others, demonstrating a clear trend of adaptive and maladaptive coping and the following behavioral changes, especially when taking into account previously reported data on the relationships between behavioral changes and psychopathological symptoms. For example, the participants reporting behavioral changes were more likely to employ maladaptive coping strategies, such as denial, substance use, self-blame or behavioral disengagement. On the other hand, those reporting no behavioral changes were found to more commonly report using adaptive coping strategies, such as acceptance, planning or seeking both emotional and instrumental support.

In relation to other studies, we could confirm the previous associations between approach-oriented coping strategies and better mental well-being. Prior research has shown that employing avoidant coping strategies more commonly in response to the COVID-19 pandemic is related to increased risk of manifesting depressive or anxiety symptoms [37]. Similarly, studies show that problem-oriented coping strategies are linked to better mental well-being. In a longitudinal study of adolescents, individuals using problem-oriented coping developed less psychopathological symptoms during the pandemic when compared to those reporting use of emotion-oriented and disengaged coping strategies [38]. Additionally, it has been shown that techniques such as mindfulness are associated with a decreased use of maladaptive coping, such as avoidant strategies. In a study by Adams et al. [39] the medical professionals were shown to exhibit a different coping pattern, namely use less spiritual coping and much more interventional coping at the second point of assessment after a year. However, this particular population has been shown to manifest higher level of negative mental health consequences with increased duration of COVID-19 pandemic.

A partial mediating role of the preferred coping style has been established between the ability to maintain an everyday routine and the level of experienced psychopathological symptoms. In this model the ability to maintain an everyday routine was directly negatively correlated to psychopathological symptoms, i.e., lower GHQ scores and the use of coping styles had an additional add-on negative effect on GHQ scores (lower scores). The opposite effect has been found for the remaining behavioral changes, such as: an increase in alcohol or tobacco consumption, relationship troubles, changes in food intake, sleeping and exercise patterns. In this model behavioral changes by itself were directly positively correlated with GHQ symptoms (higher scores), indicating that respondents who experienced behavioral changes also experienced more psychopathological symptoms, but the use of coping styles yielded a negative correlation with GHQ symptoms, i.e., lowering scores. Interestingly, although partial mediations were established for the role of coping styles in mediating the effect of behavioral changes on GHQ scores, all of the defined coping styles influenced psychopathological symptoms in a similar manner, suggesting the functional aspect of the coping style (active, avoidance or emotional) did not matter significantly.

Although coping strategies have been traditionally and popularly understood in a fairly black and white context, dividing into beneficial and effective problem-focused strategies and non-beneficial and ineffective emotion and avoidance-oriented coping strategies, some argue that this approach may be too simplistic [20, 40]. For example, avoiding thinking about a current problem in order to decrease immediate discomfort may cause the individual to experience elevated stress later when the issue eventually becomes unavoidable, prolonged or even exacerbated by time. However, avoidance by distracting oneself from an immediate problem may also lead to a decrease in stress levels, especially if the problem is not solvable at the time or the feelings associated with the event may otherwise become overwhelming. Even substance use or denial may be considered adaptive, e.g., directly after a traumatic event [20]. Both of these conditions (not solvable, overwhelming) seem to be met when thinking about pandemic-like circumstances. A similar argument can be made for emotion-focused strategies, leaving the conclusion that perhaps our research demonstrates a previously raised argument, that the context rather than the strategy itself ultimately determines its beneficial effect or lack thereof. This interpretation is confirmed by the fact that in our analyses of the role coping styles play in the development of psychopathological symptoms (GHQ) it was avoidance-based coping strategies that had the biggest influence on GHQ scores (negative) and not, as would be expected, active coping.

This was different for PTSD symptoms where different coping styles did yield different results. The results indicated no mediating effect of active coping on the relationship between behavioral changes and PTSD symptoms. A partial negative mediation has been established for emotional coping, indicating that although the presence of behavioral changes is related to an increase in PTSD symptoms some of that influence is carried by emotional coping which in turn has a negative (i.e., protective) influence on PTSD symptoms. Finally, a full positive mediation of avoidance

coping has been found between behavioral changes during the pandemic and PTSD symptoms, indicating that the full effect of behavioral changes on an increase in PTSD symptoms in this model is carried by the choice of avoidance-based coping strategies.

Both the beneficial effect on emotion-focused coping on PTSD symptoms as well as the mediating role of avoidance coping can be explained in the framework of post-traumatic stress. Anxiety-based avoidance is a prominent symptom of PTSD and post-traumatic functioning people employ to reduce their stress levels by completely (if possible) cutting all contact with triggering situations or circumstances. Although avoidance can provide for a short-term relief in the long term it typically leads to an increase in anxiety symptoms and the maintaining of the disorder by making it impossible to expose and subsequently habituate the anxiety [41, 42]. Avoidance coping has previously been linked to PTSD symptoms on several levels: research suggests that people diagnosed with PTSD are likely to use avoidance-based coping strategies [43], avoiding reminders of a traumatic event predicts PTSD symptom severity [44], as does the use of avoidance-based coping strategies in general [45].

Based on our observations, we hypothesize that three discussed domains – behavioral changes, coping strategies and mental health – can be considered as parts of a feedback loop, in which the emergence of COVID-19 pandemic negatively impacts daily behavior, resulting in deleterious behavioral changes. In turn, lifestyle changes favor the development of psychopathological symptoms, the effect of which is being mediated by the individual profiles of coping with stress. Available literature confirms that specific behavioral changes, such as sexual dysfunctions were significantly more prevalent at the time of COVID-19 pandemic [47]. Moreover, evidence exists on higher use of psychoactive substances in adolescents and negative change in eating patterns and level of physical activity in adults during the pandemic [47].

While a large portion of the general population experiences the negative short-term consequences of the pandemic, research indicates that some individuals are at risk of a significant long-term impairment of mental well-being, the fact which needs to be addressed in the preventive measures and future interventions aimed at populations such as university students. Due to the size of the at-risk population, a systematic approach to interventions, such as 4-step SBIRT (Screening, Brief Intervention, and Referral to Treatment) could prove beneficial [48].

Due to its design, our research is limited by certain noteworthy issues. Firstly, the survey was conducted online, which can slightly bias the population of university students' participants. Secondly, due to the anonymous character of the study, the two time points of measurement included different groups of students eliminating the possibility of a follow-up design

4. Conclusions

In our research we present evidence on long-lasting negative psychological outcomes of the COVID-19 pandemic. We link particular coping strategies employed in

response to the pandemic with mental well-being of participants, shedding light on the beneficial and deleterious coping with a novel global stress factor. This evidence contributes to future interventions and psychoeducation. While establishing the causality of correlations between reported changes to daily behavior and employed coping mechanisms requires further studies, our results justify the need to promote the adaptive strategies of coping in order to reduce the occurrence of psychopathological symptoms and improve mental well-being in the population of university students.

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