

Students' mental health during the Covid-19 pandemic lockdown

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Abstract

Background and Study Aim

The Covid-19 pandemic lockdown had wide-ranging consequences and disrupted many aspects of students' daily lives. One of the most affected areas was mental health, as students lost the opportunity to study in direct contact and faced new stressors related to their living, health, and financial conditions. The aim of this study is to develop a model that predicts students' mental well-being levels during pandemic periods and to design practical interventions to support mental health in crisis situations.

Material and Methods

A total of 1424 students from four Polish universities participated in the study. They filled out an original questionnaire consisting of 17 questions about basic demographic data (age, gender, career, place of living), daily time spent on physical activity, access to recreational facilities, health self-assessment, financial situation, daily time spent sitting or lying down, physical well-being, and mental well-being. The research was conducted in two stages. First, an ordinal-choice logit model was applied. The mental state was regressed against physical, financial, and health states, while controlling for gender and place of residence. Probability response analysis was carried out. Then, the actual and predicted mental state classes were compared, and the misspecified results were extracted. The differences between subsamples containing underestimated and overestimated mental states were analysed by applying Pearson's χ^2 test. The p-values were obtained through Monte Carlo simulations with 10,000 replications.

Results

The regression model revealed a positive, highly statistically significant relationship between mental state and physical, financial, and health states. The model underestimated the actual mental state for 368 respondents and overestimated it for 441. The misspecified respondents entered the "optimist" and "pessimist" subsamples, for which differences between proportions were tested. No significant differences were found for urban versus rural inhabitants ($p = 0.905$). There were significantly more women in the "optimist" subsample ($p = 0.99$). The null hypotheses of no differences between classes for physical state and health state were decisively rejected at a 1% significance level. The null for financial state was rejected at a 10% significance level.

Conclusions

Women showed higher levels of optimism than men, indicating gender differences in emotional resilience. Place of residence (urban vs. rural) had no significant effect on mental well-being. Many students demonstrated psychological resilience during lockdown, especially those with social support or effective coping strategies. Psychological counselling services are essential to strengthen coping mechanisms and support students in future pandemics.

Keywords:

COVID-19 pandemic, lockdown, mental state, well-being, students' mental health, optimism and pessimism, healthy lifestyle

Introduction

The Covid-19 pandemic became a global health crisis that profoundly disrupted social, educational, and economic systems. Students were among the groups most affected, as sudden lockdowns and

restrictions changed their daily routines, reduced opportunities for direct interaction, and limited access to academic and recreational resources. These rapid shifts created additional stressors related to financial security, health concerns, and lifestyle changes, making mental well-being a critical issue in this population. The complexity of these interrelated factors highlights the importance of examining how such circumstances shape students'

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psychological resilience and overall mental health.

The COVID-19 pandemic and all the aspects associated with it, including illness, loss of loved ones, isolation, and the need to completely give up or reduce daily activities that had a positive impact on relationships, well-being, or health, have had a huge impact on lives, both from an individual and a societal perspective [1, 2, 3, 4, 5]. During the pandemic, stopping the spread of the disease and saving human lives directly threatened by the virus and its associated complications had to be the first concern, which seems understandable. However, in any phase of the pandemic, the impact on mental health should not be neglected, and the mental health of all citizens, including those who are ill as well as the staff of various medical institutions, should be taken care of [6, 7].

The COVID-19 pandemic broadly affected physical health, mental health, and overall well-being [8]. It also affected children, adolescents, and young adults, including students, who are particularly vulnerable to its negative mental health impacts [9, 10, 11]. A study by Liang et al. conducted in China among young people (aged 4–35) in January 2020, two weeks after the pandemic outbreak, found that nearly 40.4% of them tended to have psychological problems [12]. Fruehwirth et al., conducting a study among first-year students (ages 18–20) in North Carolina, USA, aimed to determine the impact of Covid-19 stressors (including work reductions, health issues, distance learning difficulties, and social isolation) on students' mental health by analysing depression and anxiety symptoms [13]. The results indicated that general difficulties related to distance learning and social isolation increased depression and anxiety symptoms. This effect was not observed for work reductions or COVID-19 diagnosis and hospitalisation of oneself, family members, or friends.

In a study by Rutkowska et al., conducted during a remote learning period in January 2021 among Polish students, 58% of the respondents indicated that the pandemic and the difficulties associated with it had increased their stress levels, 56% showed symptoms of depression, and 18% reported suicidal thoughts [14]. In another study conducted by Wiczorek et al., nearly 77% of university students reported psychopathological problems, leading to the conclusion that students' psychological processes need to be monitored during such circumstances [15]. A study conducted by Ochnik and Ar on students from nine countries, including Poland, found that 61.3% of participants showed signs of depression [16]. During this period, individuals facing many psychological problems, and their ability to cope with these problems through optimistic or pessimistic perspectives, became a subject of interest [17, 18, 19, 20].

An optimistic attitude toward life and various

situations can benefit students, who are vulnerable young adults [21, 22, 23]. The COVID-19 pandemic and its accompanying challenges had a significant impact on mental health [24, 25]. Optimism has played an important role in coping with these negative effects [26, 27, 28]. While Genç and Arslan focused on the mediating role of optimism and hope in the relationship between coronavirus stress and subjective well-being among students in Türkiye [29], another study conducted on Italian students found a correlation between optimism and resilience with COVID-19-related stress, subjective well-being, and hopelessness [30]. Krifa et al. demonstrated that optimism exhibited by Tunisian students partially mediated the relationship between emotional regulation, anxiety, and depression, and fully mediated the relationship between emotional regulation and academic engagement [31]. These findings demonstrate that a positive or negative attitude toward a situation can lead to significant outcomes in coping with that problem [32, 33].

Previous research indicates that psychological responses to unprecedented situations such as the COVID-19 pandemic vary widely depending on demographic factors including gender, socioeconomic status, and living environment. These variations can inform targeted interventions to support students in distress [34]. In addition, studies have highlighted that students' mental health is influenced not only by external factors, such as social isolation and academic pressures, but also by individual characteristics, including coping mechanisms and social support networks [35].

Analysis of research findings has shown that students' mental health during the COVID-19 pandemic is shaped by a complex interplay of demographic, social, and individual factors. Researchers emphasize that experiences such as social isolation, academic challenges, and personal coping mechanisms may lead to varied psychological outcomes across different groups. These observations indicate the necessity of examining students' psychological well-being in pandemic conditions, with particular attention to the differences between groups that respond more positively or negatively to such crises.

Based on previous research, it can be assumed that students' mental well-being during the COVID-19 pandemic is influenced by their physical condition, financial situation, and overall health status. These factors may differentiate groups of students who show greater optimism or pessimism in response to crisis conditions. Therefore, the following hypotheses were formulated:

- (1) students' physical state is positively associated with their mental well-being;
- (2) financial situation significantly contributes to differences in mental state;
- (3) overall health status predicts variation in

students' psychological resilience.

The aim of this study is to develop a model that predicts students' mental well-being levels during pandemic periods and to design practical interventions to support mental health in crisis situations.

Materials and Methods

Participants

A total of 1424 participants were involved in the study (925 females – 65%, 499 males – 35%). The survey was performed among students of four Polish universities, with 55.8% living in rural areas and 44.2% in urban areas. The inclusion criteria were being a student of one of these universities during the COVID-19 pandemic and having the possibility to take part in the survey. Participants were informed about the purpose of the study, read and signed informed consent, and agreed to take part voluntarily. All participants were assured anonymity and informed that they could end their participation without consequences. The study was conducted in accordance with the Declaration of Helsinki, and all ethical standards for research involving human participants were strictly observed.

Research Design

The data were recorded under fixed conditions between 15 April 2021 and 24 April 2021. The relevant departments of the universities were informed in order to ensure consistency in implementation. The process was carried out under the supervision of sports experts, in accordance with the Declaration of Helsinki. Participants completed an original, structured questionnaire (provided as supplementary material) developed by the researchers, which included basic demographic data (age, gender, career, place of residence), daily time spent on physical activity, access to recreational facilities, daily time spent sitting or lying down, changes in alcohol consumption, changes in smoking habits, and changes in body mass. The questionnaire consisted of 17 questions, of which those analysed in this study focused on physical well-being, health, mental well-being, financial situation, and physical fitness on a 1–5 Likert scale. The reliability of the 4-item questionnaire was assessed using Cronbach's α , which indicated acceptable internal consistency ($\alpha = 0.713$). In addition, the subscale combining physical and health state items showed an α of 0.709. Validity was established through expert review by specialists in psychology and pedagogy, confirming the content relevance and clarity of the questionnaire items.

Procedure

The data obtained were digitised using Microsoft Excel (Microsoft 365, v2410) to create a database and then processed with statistical analyses.

Respondents evaluated their mental state using an ordinal choice variable. To detect the relationship between mental state and explanatory variables (the regressors are listed in Table 1), a variety of ordered categorical regression logistic models was applied [36, 37, 38, 39]. The final model was selected by minimizing the Schwarz information criterion (BIC). To account for heterogeneity among respondents, both location and location–scale regression models were estimated, with varying assumptions regarding the cut points (flexible, equidistant, symmetric). The minimization of BIC selected a location model with a symmetric threshold.

To identify individuals deviating from the pattern, an ordinal-choice logit model was applied to approximate the prevailing distribution. The features of the model (location/scale, threshold) were selected using the minimization of the Bayesian Schwarz information criterion. Alternative specifications, including location–scale models and machine learning approaches (gradient boosting, Bayesian regression trees), yielded slightly higher BIC values and marginally lower McFadden's pseudo- R^2 (0.149–0.150) than the selected location model with symmetric threshold, with no substantial gain in predictive accuracy. Given these results, the location model with symmetric threshold was preferred for its parsimony and interpretability.

Apart from the BIC, the models' log-likelihoods and coefficients of determination were also inspected. For the latter, the standard McFadden pseudo- R^2 was estimated and the Ugba and Gertheiss correction applied, which penalises for the number of cut points [40]. In the next step, the confusion matrix was estimated to evaluate predictive accuracy. Only slight differences in predictive accuracy were detected between models, appearing at the third decimal place. Thus, the confusion matrix did not influence model selection.

Probability-response analysis (PRA) was performed to depict the impact of explanatory variables on mental state. PRA traces the responses of the explaining variable to changes in explanatory variables. In performing PRA, the values of financial, wealth, and health states were varied according to the Likert scale used in the survey, whilst for gender and place of residence, the respondent was assumed to be a female living in an urban area. PRA employs the estimated coefficients to compute probabilities of a specific mental state in response to changes in selected regressors. It is similar to obtaining marginal effects (see, e.g., Agresti and Tarantola, 2018 [41]), with the difference being a sequentially repeated probability estimation for varying values of regressors.

For example, the probability that the mental state was evaluated at level 1 was estimated as a function of $X_1=X_2=1$, with other regressors X fixed at level x :

$$Prob(M = 1 | X_1 = 1, X_2 = 1, X = x)$$

Next, the conditional probability that the mental state was evaluated at level 1 was estimated for $X_1=2,3,\dots,n$, with X_2 fixed at 1 and $X=x$:

$$Prob(M = 1 | X_1 = 2, X_2 = 1, X = x)$$

...

$$Prob(M = 1 | X_1 = n, X_2 = 1, X = x)$$

The estimations were then repeated for $X_2=2,3,\dots,m$, with X_1 fixed at 1:

$$Prob(M = 1 | X_1 = 1, X_2 = 2, X = x)$$

...

$$Prob(M = 1 | X_1 = 1, X_2 = m, X = x)$$

This procedure was repeated for the remaining mental states 2, 3, 4, and 5. The PRA results were presented as three-dimensional or two-dimensional figures, showing how probabilities evolved alongside changing values of explanatory variables. For simplicity, the explanatory states not depicted in graphs were fixed at $X=x=3$.

The ordinal choice model and the PRA focused on the prevailing pattern governing students' perception of their mental state. To identify potential "optimistic" and "pessimistic" outliers among students, the next step of the analysis compared actual classes with predicted ones. Two subsamples were compiled, consisting of respondents for whom the model returned an inaccurate prediction. Differences between the subsamples were examined using the two-proportion z-test for binary explanatory variables (gender, place of residence) and Pearson's test, with p-values obtained through Monte Carlo simulations with 10,000 replications.

Statistical analysis

The data were digitized using Microsoft Excel (Microsoft 365, v2410) to create a database and subsequently analysed in the R programming language (ordinal package). Figures were prepared with the plotly package. Model fit was evaluated using the Schwarz information criterion (BIC), log-likelihoods, and coefficients of determination (McFadden's pseudo- R^2 with the Ugba and Gertheiss correction). Predictive performance was assessed using a confusion matrix. A significance level of $p < 0.05$ was adopted for all statistical tests. The internal consistency of the 4-item questionnaire was verified using Cronbach's $\alpha = 0.713$.

Results

Controlling for physical, health, and financial states, as well as gender and place of residence, all regressors were statistically significant at standard significance levels. The estimated coefficients, their standard errors, and threshold parameters are presented in Table 1. The model's goodness-of-fit was evaluated using the McFadden pseudo- R^2

(0.151) and the Ugba and Gertheiss modified McFadden R^2 (0.149) [40], indicating modest explanatory power despite statistically significant associations. Based on the confusion matrix, overall accuracy was 43.2%, with most misclassifications occurring between adjacent categories, particularly between mental state levels 2 and 3, and levels 3 and 4. Sensitivity was highest for category 5 (0.78) and lowest for category 2 (0.62).

Table 1. Ordinal logistic regression results (N = 1424).

Variable	Coefficient	Std. Error
Physical State	0.773	0.065**
Health State	0.702	0.072**
Financial State	0.465	0.056**
Gender	-0.526	0.104**
Place of Residence	-0.166	0.056*

Note: Threshold coefficients — Central 1: 5.153 (SE = 0.315); Central 2: 6.780 (SE = 0.335); Spacing: 1.992 (SE = 0.070). Model fit — BIC = 3694.155; log-likelihood = -1818.032; McFadden pseudo- R^2 = 0.151; Ugba & Gertheiss modified McFadden R^2 = 0.149. Significance levels: ** $p < 0.01$; * $p < 0.10$.

As shown in Table 1, all regressors were statistically significant at conventional levels. The relatively low pseudo- R^2 values indicate modest explanatory power, although the associations were statistically robust. Model accuracy based on the confusion matrix was 43.2%, with most misclassifications occurring between adjacent categories, particularly between mental state levels 2 and 3, and levels 3 and 4. Sensitivity was highest for category 5 (0.78) and lowest for category 2 (0.62).

As shown in Table 1, the coefficients for physical, financial, and health states, as well as gender, were significant at the 1% level, while the coefficient for place of residence was significant at the 10% level. The McFadden pseudo- R^2 and the modified version were 0.151 and 0.149, respectively. The confusion matrix indicated that the model correctly predicted 43.2% of mental state evaluations. Attempts to improve the fit by applying location-scale models or machine learning algorithms did not increase predictive accuracy.

The probability-response analysis (PRA) revealed the prevailing pattern in the data. As expected, the probability of selecting a higher mental state increased with higher values of financial, health, and physical states. To illustrate this result, two extreme cases were analysed. When respondents assigned a value of 1 to financial, health, and physical states, the highest estimated probability was $Prob(M=1)=0.871$. Conversely, when these states were assigned the value 5, the highest estimated probability was $Prob(M=5)=0.558$. Figure 1a depicts the PRA results

for choosing Mental State = 3, and Figure 1b depicts the PRA results for choosing Mental State = 4. In both cases, the estimated probabilities increased alongside the values of financial and physical states. Additionally, Figure 2 presents the PRA results obtained by varying the health state and fixing the remaining explanatory states at 2 (Figure 2a) and 5 (Figure 2b). This analysis confirmed that selecting higher-valued explanatory states substantially increased the probability of evaluating the mental state at a higher level.

As shown in Figure 1 and Figure 2, the prevailing pattern of probabilities allowed the identification of optimistic and pessimistic respondents. In total, 368 respondents were identified for whom the model underestimated their actual mental state. Among

these, 68 respondents exhibited a state difference exceeding 1 (for example, respondent #30 indicated a mental state of 5, while the highest probability was estimated for class 3). For 441 respondents, the model overestimated their mental state. The main features characterizing the “optimist” subsample (actual state greater than expected) and the “pessimist” subsample (expected state greater than actual) were reconstructed. The subsequent part of this section presents the results for these subsamples.

As shown in Table 2, the binary dummy variables controlling for place of residence and gender were first examined. The test results indicated no significant differences in proportions between urban and rural inhabitants (p -value = 0.905). However,

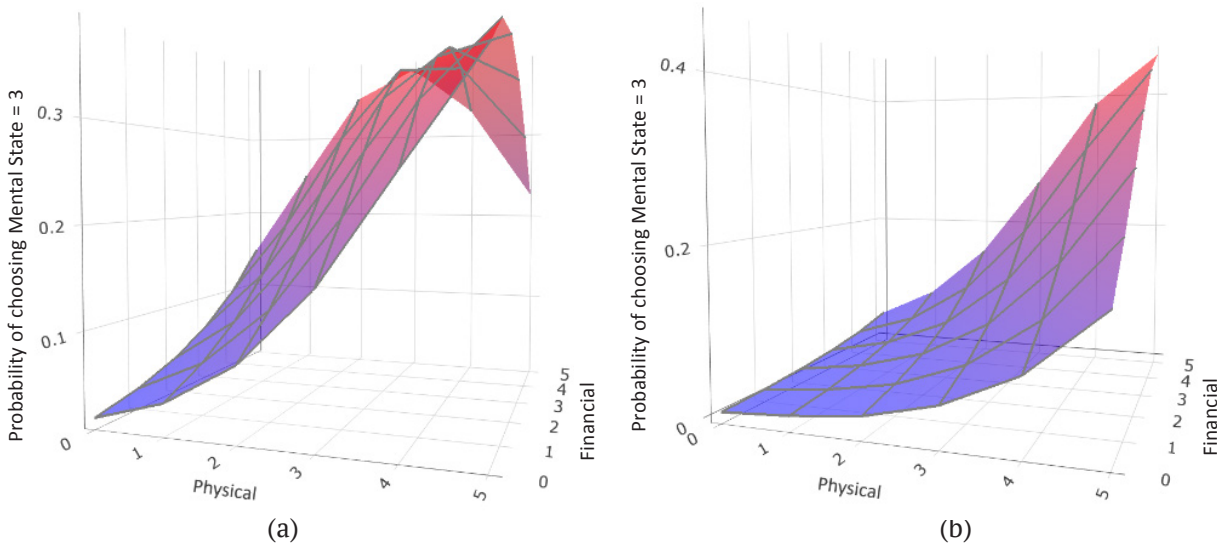


Figure 1. Probability-response analysis results: (a) probability of choosing Mental State = 3; (b) probability of choosing Mental State = 4.

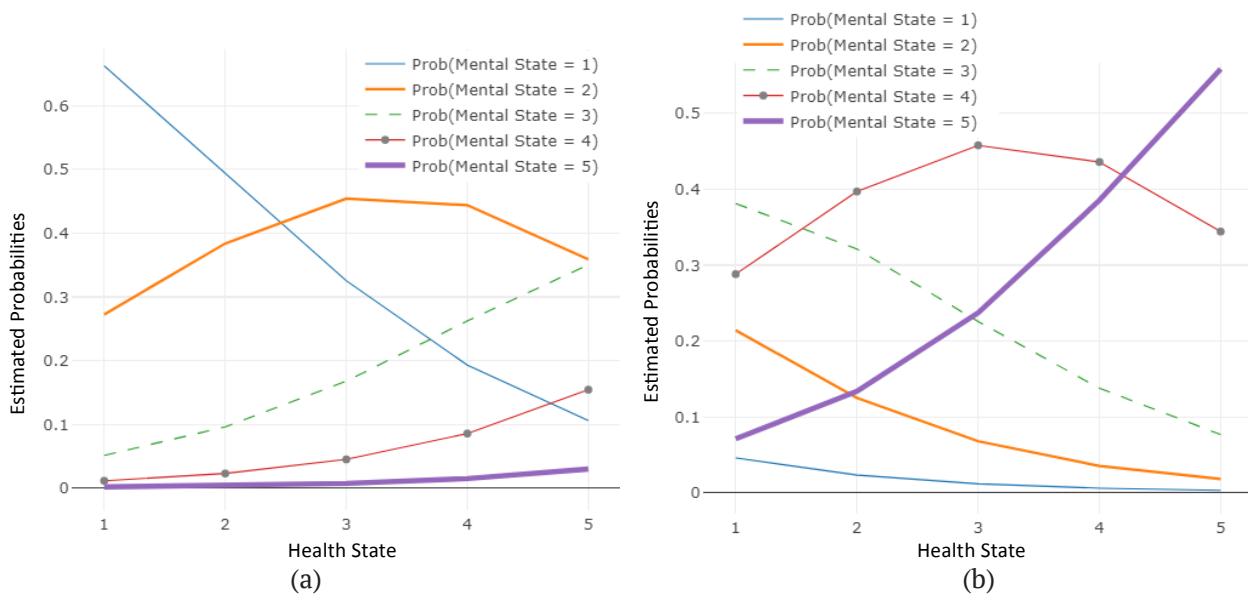


Figure 2. Probability-response analysis results for: (a) Physical State = Financial State = 2; (b) Physical State = Financial State = 5.

Table 2. Number of respondents in subsamples for gender and place of residence.

Regressors	Optimist Subsample	Pessimist Subsample
Gender		
Females	260 (70.7%)	276 (62.6%)
Males	108 (29.3%)	165 (37.4%)
Place of Residence		
Urban Area	161 (43.8%)	190 (43.1%)
Rural Area	207 (56.3%)	251 (56.9%)

Table 3. Test results for physical state, health state, and financial state.

Null Hypothesis	Test Statistic	p-value
No differences between physical state classes in optimistic and pessimistic subsamples	53.128	0.000
No differences between health state classes in optimistic and pessimistic subsamples	31.209	0.000
No differences between financial state classes in optimistic and pessimistic subsamples	8.796	0.069

the proportion of females was significantly greater in the optimist subsample (p-value = 0.99).

To test for differences in proportions between classes in the remaining explanatory variables, the Pearson's χ^2 test was applied, with p-values obtained through Monte Carlo simulations with 10,000 replications. As summarized in Table 3, the null hypotheses of no differences between classes for physical and health state were decisively rejected at a 1% significance level, whilst the null for financial state was rejected at a 10% significance level.

Further inspection of the subsamples (Table 3) shows a considerable shift in the probability mass towards classes 4 and 5 for the pessimist subsample. Respondents in the optimist subsample chose lower-valued classes much more frequently than their counterparts. Returning to the PRA results (Figures 1 and 2), the analysis indicated a positive relationship between mental state evaluation and explanatory states. This tendency also influenced the identification of "pessimists" and "optimists." Individuals whose expected mental state was higher than their actual level most likely perceived their financial, physical, and health states lower than their mental state, and vice versa.

As shown in Figure 3, the relative frequencies per class are presented for the optimist (Figure 3a) and pessimist (Figure 3b) subsamples. The probability mass for the pessimist subsample was shifted towards classes 4 and 5, with cumulative relative frequencies exceeding 50% for all reported states. In the optimist subsample, the lower-valued classes dominated the physical state, accounting for 62.8% of the cumulative relative frequency. Although respondents assigned their health and financial states more frequently to classes 4 and 5 than to the physical state, the cumulative

frequencies in the pessimist subsample were higher. The estimated p-values for the null hypothesis of a greater proportion of classes 4 and 5 in the pessimist subsample were 0.993 for financial state, 1.000 for health state, and 1.000 for physical state.

Discussion

The aim of this study was to develop a model predicting students' mental well-being during the COVID-19 pandemic on the basis of their health, physical, and financial conditions, while also examining the influence of gender and place of residence. The applied questionnaire demonstrated acceptable reliability, as indicated by Cronbach's (0.713), and its content validity was confirmed through expert evaluation.

The estimation results indicated that physical, financial, and health states had a highly significant, although limited, impact on students' mental state. Gender and place of residence also contributed significantly to differences in mental well-being. Despite modest goodness-of-fit and predictive power, the model's performance was comparable to that reported in other large survey-based studies. Misclassified cases provided an additional perspective by identifying respondents whose mental state was systematically over- or underestimated, revealing further nuances in the relationship between well-being and explanatory factors. Taken together, the findings demonstrate that students' mental health during the pandemic was strongly connected with lifestyle and socioeconomic conditions, while individual differences, including physical activity, played a particularly important role.

Regular physical activity is associated with improved mental health, including reduced risks of anxiety, depression, and cognitive decline.

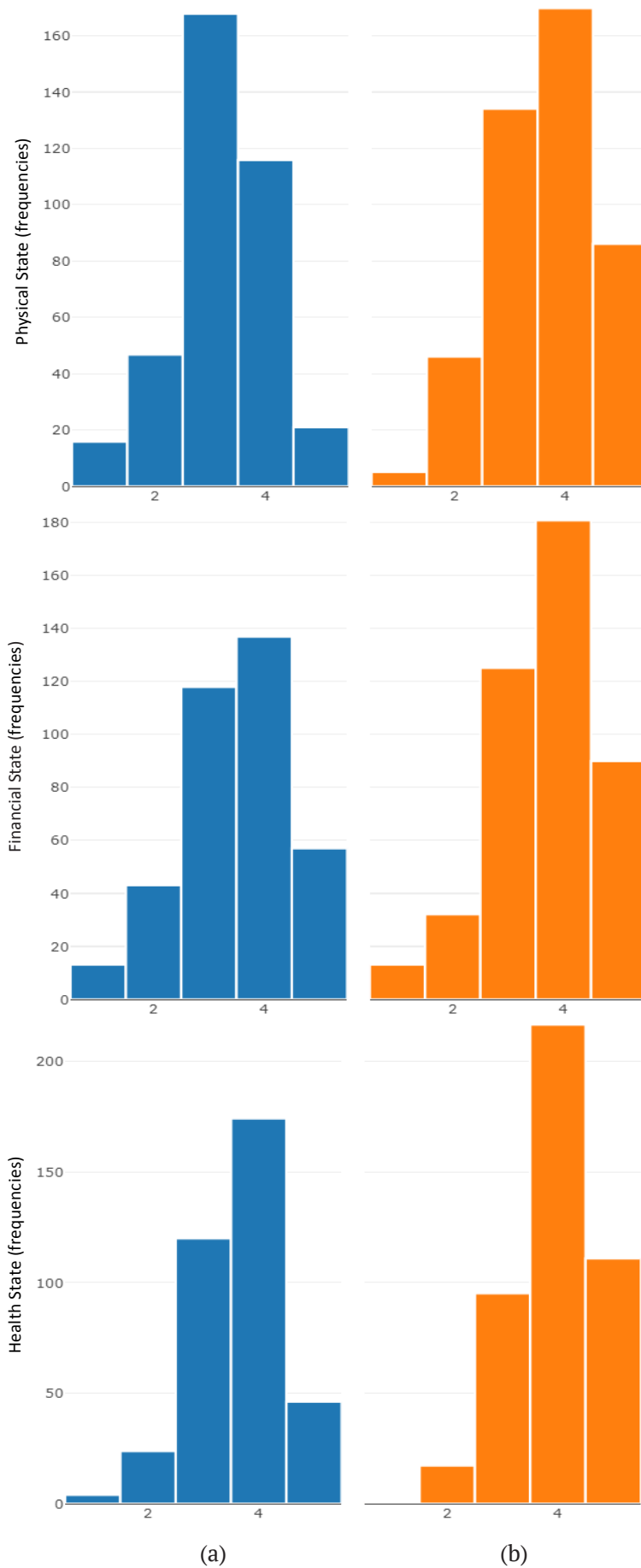


Figure 3. Relative frequencies for: (a) optimist subsample; (b) pessimist subsample.

Physical exercise has been shown to improve mood, reduce stress, and enhance sleep quality, all of which contribute to mental well-being. Even small amounts of physical activity can provide measurable mental health benefits across various age groups [42]. People with insufficient physical activity reported a poorer mental state than those who were physically active during the COVID-19 pandemic [43]. The results of this study also indicated that psychological problems related to the COVID-19 pandemic were less pronounced among individuals with higher levels of physical activity. These findings suggest that, in addition to physical activity, economic factors also influence mental health and that financial stress has a marked impact on students.

One of the observations from this study was that students experiencing financial stress reported greater effects of the pandemic. Evidence from the literature indicates that financial stress is a factor contributing to mental health problems, including depression. Individuals with financial difficulties often report increased levels of anxiety and depressive symptoms, while financial stability can support mental health by reducing stress and reinforcing a sense of security [44]. The relationship between health, financial circumstances, and physical activity underscores the relevance of a holistic approach.

When considered together, financial freedom is thought to have a positive effect on participation in physical activity. A broader approach to health suggests that positive changes in any of these areas can improve overall mental health. For example, a healthy lifestyle combined with financial security and regular physical activity contributes to long-term mental stability and happiness [42]. These findings emphasize the importance of an integrated approach to health, addressing both mental and physical well-being, as well as financial stability. While supporting the existing holistic pattern, the model revealed that mental states have a persistent aspect that cannot be explained by external factors alone.

The model identified a similar pattern in the survey data, showing that the probability of choosing a higher-valued mental state increased alongside the increasing values of the other states. As shown in Figures 1 and 2, the responses were influenced by the assumptions regarding the evaluation of mental, physical, and health states. The grey-shaded areas represent the probability of selecting mental state = 3 (left panel) and 4 (right panel) in response to changes in financial and physical states. In both panels the probabilities increased with higher evaluations of respondents' financial and physical states. This situation highlights the importance of addressing psychological processes such as personal well-being and depression through financial

freedom and participation in physical activity, as indicated in the literature.

Nevertheless, the self-assessment of the mental state may display a degree of persistence that is not explained by financial, physical, and health states. Research exploring the persistence of self-assessed mental states suggests that such assessments may show stability or "stickiness" beyond the immediate influences of external factors such as physical health, financial status, or overall well-being. One explanation for this is linked to self-determination theory, which emphasizes that individuals' internal motivation and autonomy are key drivers of persistent mental states. For example, people with stronger internal motivation, stemming from personal beliefs or intrinsic values, often maintain a stable mental state even in the face of external changes like health or financial instability [45].

Another contributing factor is the individual's perception of control over life and environment. Studies suggest that individuals who perceive a high level of personal agency report higher psychological resilience and maintain their mental well-being despite changes in external conditions [46]. Cognitive biases, such as confirmation bias, may also lead individuals to interpret new experiences in ways that reinforce their pre-existing mental self-assessments, further stabilizing these mental states over time [47]. These findings indicate that self-assessed mental health can persist due to internal cognitive and emotional factors that are not directly explained by changes in physical or financial conditions.

In the extreme case of a lockdown environment, explanatory states may have only a limited impact on mental state. Previous research has shown that the negative effects of pandemics and lockdown on mental state were moderated by decision-making processes [Barone] and that fostering a positive attitude and emotional control could mitigate the adverse effects [48]. The results obtained suggest that the process of mental well-being develops under the combined influence of psychological (internal) and economic (external) factors. The literature supports this complexity, indicating that while certain groups are more affected, the overall impact on mental health is less severe than initially expected.

Research on the psychological effects of COVID-19 lockdowns indicates that the overall impact on mental health was moderate and varied across individuals and contexts. A meta-analysis of longitudinal studies found that the psychological consequences of lockdowns in the general population were smaller than initially expected, with many people demonstrating resilience to the restrictions. This tendency was also observed among health professionals, including medical students. A survey conducted at the end of the

pandemic in 2022 reported lower levels of anxiety compared with the beginning of the pandemic in 2020, although higher stress levels were observed in female respondents [49]. The effects of lockdowns were more pronounced among subgroups with pre-existing mental health conditions, limited social support, or financial difficulties. These factors explained much of the psychological distress, rather than the lockdown itself exerting a direct and uniform effect on mental health [50].

These findings suggest that although lockdown conditions limited physical [51] and social activities, the persistence of mental distress was not fully explained by external factors such as finance or health. Individual resilience played an important role, indicating that the influence of lockdowns on mental health was nuanced and dependent on personal circumstances and protective factors. The quantitative analysis reflected this complexity, as the model identified statistically significant associations while demonstrating only modest explanatory power. This combination supports the interpretation that persistence and individual heterogeneity are key elements in understanding students' self-evaluation of mental state. Despite the limitations of the model, the differentiation into optimistic and pessimistic subsamples provided additional insight into cases where predictions and actual self-assessments diverged.

Two subsamples of misclassified respondents were constructed. The model underestimated the mental state of 368 respondents (25%) and overestimated it for 441 respondents (31%). For clarity, the former are referred to as "optimists" and the latter as "pessimists."

The analysis of relative and cumulative frequencies highlighted gender differences between the subsamples. Women accounted for 70.7% of the optimist subsample and 62.6% of the pessimist subsample, whereas the proportions of urban residents were 43.8% and 43.1%, respectively. The results indicate that women were more represented than men in both subsamples, particularly in the optimist group.

The gender composition of the subsamples is consistent with the literature, which suggests that women often report higher levels of optimism compared with men. This tendency may be linked to socialisation, coping strategies, emotional expression, or social support networks. Such factors could explain the higher proportion of women in the optimist group, with the difference supported by a p -value of 0.99.

Regarding urban and rural residency, no significant differences were observed between optimists and pessimists ($p=0.905$). The nearly equal percentages of urban residents in both subsamples indicate that place of residence does not play a decisive role in shaping optimism or pessimism.

Instead, other factors such as socioeconomic conditions or personal experiences may exert a stronger influence. These results, combined with the gender-related findings, suggest that mental attitudes are shaped by a wider set of determinants beyond the physical environment [47].

Gender and place of residence influenced mental state, yet the distribution of physical, financial, and health states in the pessimist and optimist subsamples provided deeper insight into the persistence of mental state evaluation. As shown in Figure 3, pessimists tended to concentrate in higher-valued categories of physical, health, and financial states, whereas optimists more often reported lower values, particularly for physical state. This contrast illustrates that self-assessment of mental state does not always correspond directly to external conditions but reflects individual perception and resilience. The findings point to the sensitivity of students to crisis situations and highlight the importance of targeted support and intervention strategies during future disruptions.

Limitations of the Study

This study has several limitations that should be acknowledged. Although the sample included a large number of Polish students, it may not fully represent all university populations across the country, as regional economic conditions and differences in lockdown restrictions could influence the results. The predictive accuracy of the model was modest, with only 43.2% of mental state evaluations correctly classified, indicating the need for future studies that incorporate additional explanatory variables. Another limitation is the reliance on self-reported questionnaires, which may introduce bias due to social desirability or misunderstanding of the items. The study was conducted during a specific stage of the lockdown, so the findings may not capture changes in students' psychological states during other phases of the pandemic, such as re-openings or subsequent restrictions. Furthermore, the analysis focused on the immediate effects of lockdown and did not address potential long-term consequences of sustained or repeated lockdowns, which may affect mental well-being differently over time. These limitations point to the importance of future research that includes more diverse samples, longitudinal designs, and a broader range of well-being indicators.

Future Research Directions

Future studies should investigate the personal and environmental factors that contribute to resilience in students, including coping mechanisms, family support, financial aid, and access to mental health services. A deeper understanding of these factors could help to design targeted interventions aimed at supporting vulnerable student populations. Such

investigations would provide a more comprehensive view of how lockdowns influence student well-being and could inform more effective responses to future public health crises.

Practical Applications

The findings of this study have several practical implications. Universities can use the results to develop targeted mental health services, such as counselling or peer support groups, delivered both in person and online to ensure accessibility during lockdowns or other disruptions. Health and wellness programs that encourage physical activity, mindfulness, and stress management may also help students maintain their well-being under conditions of restricted mobility. In addition, the results can guide universities and government institutions in building more resilient mental health frameworks for future emergencies, providing students with the psychological resources needed to cope with crisis situations. By applying these measures, educational institutions can support students' mental health and academic success more effectively during periods of disruption.

Conclusions

This study on the mental health of Polish students during the COVID-19 lockdown identified several important patterns. Students with effective coping strategies and strong social support demonstrated greater psychological resilience, while those experiencing economic difficulties or previous mental health problems were at higher risk. Female

students reported higher levels of optimism than male students, suggesting gender-specific coping strategies during crisis periods. By contrast, place of residence did not significantly affect mental well-being, indicating that personal and social factors are more influential than geographical location. These findings provide guidance for educational institutions in preparing targeted support systems and management plans for future crises, including accessible psychological services and effective online education strategies.

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Conflict of Interest

The authors declare no conflict of interest.

Data Availability Statement

Participants completed an original, structured questionnaire developed by the researchers, which included basic demographic data, daily time spent on physical activity, access to recreational facilities, sedentary behaviour, lifestyle changes, and self-assessments of health and well-being. The full version of the questionnaire is available in the supplementary dataset [52].

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