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Pandemic Disease Anxiety Scale – development and validation of a 17-Item self-reported scale

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Abstract

Introduction and Objective. The aim of the study was to develop and validate a questionnaire designed to assess the severity of fears in relation to the risk of infectious diseases. The scale was developed for use in a study of individuals facing the challenges of the ongoing pandemic. The global spread of infectious diseases has resulted in widespread concerns and anxiety among individuals worldwide. The present study developed the Pandemic Disease Anxiety Scale (PDAS-17) to provide additional support to clinical efforts in diagnosing the fears and anticipated problems of individuals in a pandemic situation. This will enable the implementation of effective preventive and therapeutic measures.

Materials and Method. The study included 775 respondents. Exploratory Factor Analysis (EFA) was used to analyse the psychometric properties of the test. The EFA was performed using SPSS software with Principal Axis Factoring (PAF) and promax rotation.

Results. The scale demonstrates robust psychometric properties and is an effective tool for assessing the specificity and severity of fears associated with pandemic threats and traumatic events. The factor loadings for the latent variables demonstrate a robust correlation between the observed items and their corresponding latent constructs. All factor loadings are statistically significant ($p < 0.001$), indicating that the items effectively measure their intended constructs.

Conclusions. The Pandemic Disease Anxiety Scale effectively measures multiple dimensions of fear related to the pandemic. The strong factor loadings, significant covariances, and adequate variability in item responses, all contribute to the robustness of the questionnaire. These findings validate the use of this tool for assessing pandemic disease in various contexts.

Key words

anxiety, psychometrics, Covid-19, pandemic diseases

INTRODUCTION

Infectious diseases continue to represent a significant threat to public health worldwide. Historical evidence demonstrates that the world has periodically been confronted with novel variants of pathogenic viruses, which have resulted not only in consequences for physical health but also have had a significant impact on mental wellbeing. From a historical perspective, the most significant pandemics include the Black Death, which originated in Asia and subsequently spread across Europe and North Africa during the 14th century. Conversely, at the outset of the 20th century (1918–1919), the 'Spanish flu' decimated the global population. In contrast, the H_2N_2 virus caused the 'Asian flu' pandemic between 1956 – 1958, and the H_3N_2 virus (Hong Kong flu) posed a threat to life and health between 1968 – 1970 [1, 2]. There has been considerable public concern surrounding AIDS (Acquired Immunodeficiency Syndrome), which is caused by HIV (human immunodeficiency virus) infection of immune cells. The latest estimates suggest that there are currently 37.9 million people living with HIV (PLWH) globally [3]. In the context of the 21st century, research indicates that during the 2009–2010 Swine Flu pandemic [4] and the 2015–2016 Zika virus outbreak [5], among others, there was a correlation between health anxiety and enhanced fear. Nevertheless, the most rigorous scientific inquiry has been conducted in relation to the current pandemic, which has spanned the globe and caused severe chronic stress for many people. The World Health Organization (WHO) has designated the novel coronavirus pandemic as a public health emergency of international concern, given that it has led to health problems for millions of people worldwide and affected mental health disorders [6].

It is evident from both observational studies and research that the Covid-19 pandemic has resulted in prolonged stress and collective trauma for many individuals [7, 8]. It is becoming increasingly evident that the psychological impact of the coronavirus is likely to persist for a considerably longer period than the pandemic itself. It is regrettable that the most pressing concern is the prevalence of psychological disorders resulting from the stress associated with the Covid-19 pandemic. As studies have shown, the prevalence of worrying information about the consequences of Covid-19, as well as fears of the next wave of the pandemic due to further coronavirus mutations, has been linked to an increase in the severity of depressive symptoms, anxiety and sleep disorders [9, 10, 11, 12]. Individuals experiencing additional stressors, as well as the elderly with pre-existing mental

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health conditions, are at the greatest risk of experiencing negative effects on their mental health [8, 13, 14, 15, 16].

It is therefore instrumental to reinforce the sense of security among the general public. As Pappas et al. [17] correctly point out, a key distinction between infectious diseases and other conditions is the heightened level of anxiety they often evoke. Fear is directly related to high morbidity and mortality rates, as well as the speed of transmission (invisibly and rapidly). Psychosocial challenges, including loss, stigma and discrimination, are other concerns [11]. Furthermore, fear can exacerbate the damage caused by the disease itself [18, 19].

The key to preventing the mounting of mental health disorders is the early detection of anxiety in a pandemic situation. In response to the outbreak of the novel coronavirus (Covid-19), a range of scales have been developed to rapidly assess the severity of stress and anxiety caused by threats to health and life. Some researchers have adapted existing tools to better suit the needs of this ongoing event, such as the current pandemic. In addition, Eubank et al. [20] refined the Perceived Stress Scale (PSS-10) as originally developed by Cohen et al. [21] to measure general life stress and the IES Event Impact Scale [22] to assess retrospective stress related to a specific event. One item (controlling for irritability in our lives) was removed from the PSS-10, and three items from the IES (nutrition, physical activity and aversion to vaccination) were added to the new scale. The authors designated this scale as the PSS-12. They conducted a psychometric analysis of its properties at a four-year study in an institution serving Latinos in the Bronx, NY. Their findings indicate that the scale demonstrated high internal consistency, with a Cronbach's alpha score of.90 for faculty and.90 for students.

The 15-item Perceived Vulnerability to Disease Scale (PVDS) [23] is also used to analyse perceived susceptibility to infectious diseases. Participants indicate their level of agreement with the statements using a seven-point Likert scale, ranging from 'strongly disagree' to 'strongly agree'. The perceived infectiousness of the participants was gauged based on statements such as 'I am generally very susceptible to colds, flu and other infectious diseases'. The aversion to germs was analysed based on responses related to different situations of exposure to the coronavirus, for example, 'I prefer to wash my hands fairly quickly after shaking hands with someone'. A higher score indicates a greater fear of perceived susceptibility to disease. The Cronbach's α coefficient for the total PVDS score is.70, while the coefficients for perceived infectiousness and aversion to germs are.72 and.70, respectively [23].

Bernardo et al. developed an 11-item CPAS-11 (Coronavirus Pandemic Anxiety Scale) to identity persons who need mental health services due to the Covid-19 pandemic. The scale was validated in a Filipino sample of 925 participants. A two-factors structure was identified and confirmed, corresponding to somatic (factor 1- Cronbach's α=.87) and non-somatic (factor 2- Cronbach's α=.82) symptoms of anxiety related to pandemic [24].

It seems that for effective screening of mental health issues, it is instrumental to assess not only the level of stress and the sense of control over it, but also to analyse the specific symptoms and fears experienced in a given stressful situation. The most popular is the Fear of Coronavirus Scale (FCV 19S). Ahorsu et al. developed this tool, comprising a seven-item scale with robust psychometric properties. Cronbach's α= of the original version was.82 [25]. The scale is reliable and valid for use in assessing fear of the novel coronavirus (2019-nCoV) among the general population. The scale focuses on subjective feelings and psychosomatic symptoms experienced when focusing on the consequences of the coronavirus. The Ahorsu et al. scale has a number of versions in many countries worldwide, including the Italian adaptation of the Fear of COVID-19 Scale FCV 19S which has also 7 items. The loadings on the factor were significant and strong, from.684 to.897, the internal consistency was very good – Cronbach's α=.87 [26]. The French FCV 19S version demonstrates a stable uni-dimensional structure with robust psychometric properties (strong internal consistency, good convergent and diver gent validity, and good test-retest validity) [27]. On the other hand, the German version of the Fear of COVID-19 Scale (FCV 19S), based on Confirmatory Factor Analysis, supported both a two-factor structure (emotional and somatic fear) and a more parsimonious one-factor model. Among demographic variables, only female gender was positively associated with the FCV-19S. Results suggest that the scale has good psychometric properties in German and can be used in future work [28]. The Polish adaptation of FCV-19 by Chodkiewicz and Gola is characterized by satisfactory validation (Cronbach's α=.84) [29]. Among Palestinians, Khalili constructed and validated a scale to measure the fear of COVID-19 based on a sample size of (885) respondents, with the study designed to provide an optimal cut-off score for diagnosing corona-phobia. Factorial validity using EFA and CFA revealed a consistent and stable structure with a four-factor solution covering 13 items measuring (a) Fear about Others due to COVID-19, (b) Virus Threat and Dangerousness, (c) Pessimism about COVID-19's Course, and (d) Infection Phobia (Cronbach's α=.88 for a total scale) [30].

The above scales were designed to assess the level of emotional tension and psychosomatic symptoms, as well as the personal and social factors that trigger fears of infectious disease. Most of them are limited to one culture only. Existing scales (a) focus on a single virus, (b) relegate health, social and economic fears to a single factor, or (c) rely on one-dimensional scores. Therefore, the need to construct our own scale to diagnose the severity of fears of various factors, to form the basis for preventive and therapeutic interventions. This scale is more universal: it can serve as a ready-to-use tool in the event of another pandemic or any other high-stress or traumatic situation, and it enables quick identification of individuals experiencing excessive anxiety who may require psychological intervention. PDAS is the first measure to capture four theoretically distinct domains across any viral outbreak, making it suitable for future pandemics.

Following a comprehensive review of the literature and participant observations, a scale comprising 17 statements pertaining to anticipated risks and associated reactions was developed (Tab. 1). Participants rated each item on a ten-point scale (from 'strongly disagree' to 'strongly agree'), with approximately half of the items reverse-scored.

OBJECTIVE

The aim of the survey was to analyse the specificity of anxiety related to viral diseases in a health-threatening situation, using a scale of our own design – the Pandemic Disease Anxiety Scale. The analyses aimed to assess the usefulness of the scale in situations of experiencing biological threats.

PSYCHOMETRIC EVALUATION OF THE PANDEMIC DISEASE ANXIETY SCALE MATERIALS AND METHOD

Survey respondents. The survey comprised 775 respondents whose data were used to develop and identify the core dimensions of the Pandemic Diseases Anxiety Scale design. The respondents completed a series of items designed to measure various aspects of anxiety associated with the COVID-19 pandemic. The total sample of 775 respondents included 82.7% women and 17.3% men. The participants were were young adults (20–35 years old), Polish citizens living in various regions of the country. The majority of respondents (60.6%) were between 20 – 24-years-old. The largest group (37%) were residents of large cities with a population exceeding 100,000 people; the next largest group (17.5%) lived in medium-sized towns, while 11.4% resided in small towns. The remaining 34.1% were residents of rural areas. In terms of educational background, 15.7% had vocational education, 55.3% had secondary education, and higher education – 29%.

The research was conducted via an online survey. The participants were recruited openly through social media, with the link to the survey distributed across various discussion groups, including but not limited to Facebook, and other platforms. This enabled the survey to reach a broad cross-section of individuals, who were able to complete the survey anonymously, thus ensuring the freedom to provide honest answers. The recruitment process ran from 22 April 2020 – 12 April 2023; participation was voluntary. The survey questions covered basic socio-demographic data, mental and physical health status, and the impact of the Covid-19 pandemic on these factors.

Development of the Pandemic Disease Anxiety Scale. The scale was developed to assess fear related to the ongoing pandemic. This involved creating items that capture various dimensions of fear, including health concerns, economic worries, and social anxieties. Twenty-five measures of fear were identified, assessing fear of different infectious diseases and populations (available on request from the corresponding author). Of these, 17 items were selected by a team of psychologists and public health experts to ensure that they comprehensively covered the aspects of fear relevant to the pandemic context. The structure of the scale, taking into account individual statements, was designed by a team of psychologists and public health experts to ensure that it comprehensively covered the different aspects of fear(s) relevant to the pandemic.

Respondents completed the Pandemic Disease Anxiety Scale through self-reporting. Data was collected and anonymized for analysis.

Analyses. All statistical analyses were conducted in R (Version 4.2.3; RStudio 2024.02.0) with the *psych* (Version 2.3–9) and *lavaan* (Version 0.6–15) packages. After listwise deletion of missing values on the 17 Pandemic Disease Anxiety Scale (PDAS) items, the analytic sample comprised N = 773 respondents.

A reproducible split-sample strategy was implemented to separate exploratory and confirmatory work. Using set.seed(2025), n = 300 cases (≈ 40% of the dataset) were randomly assigned to an exploratory subsample, and the remaining n = 473 cases served as a hold-out set. In the exploratory subsample, principal-axis factoring with promax rotation was performed. The number of factors was established through parallel analysis, the Kaiser criterion (eigenvalues > 1), and visual inspection of the scree plot. Items were retained when their primary loading met or exceeded.40 and all cross-loadings remained below.30, resulting in a four-factor solution consistent with the theoretical structure of the PDAS.

The prespecified four-factor model was then evaluated in the hold-out sample via confirmatory factor analysis estimated with robust maximum likelihood (*MLR*, mimic = 'MPLUS'). Model adequacy was judged against conventional benchmarks for χ^2/df, robust Comparative Fit Index (CFI), robust Tucker–Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA) with 90 % confidence intervals, and Standardized Root Mean Square Residual (SRMR).

Internal consistency for each PDAS subscale was assessed with Cronbach's α and McDonald's ω. Construct validity was examined in two steps: (a) convergent evidence was obtained by correlating the total PDAS score with the Perceived Stress Scale–10 (PSS-10), and (b) discriminant evidence was obtained by correlating the PDAS score with chronological age.

The variables covered by the analysis included: PDAS_1, PDAS_2, PDAS_3, PDAS_4, PDAS_5, PDAS_6, PDAS_7, PDAS_8, PDAS_9, PDAS_10, PDAS_11, PDAS_12, PDAS_13, PDAS_14, PDAS_15, PDAS_16, PDAS_17.

RESULTS

The Exploratory Factor Analysis (EFA) of the Pandemic Disease Anxiety Scale identified four factors, each represented by specific items with significant loadings. The factor loadings matrix indicates which items have the strongest correlation with each factor, highlighting the key items that define each dimension of fear (Table 1).

Table 1. Exploratory Factor Analysis (EFA) of Pandemic Disease Anxiety Scale (PDAS-17)

Item	Item content	F1	F2	F3	F4
PDAS 1	Fear of being hospitalised	.70	—	—	—
PDAS 2	Fear of losing loved ones	.76	—	—	—
PDAS 3	Fear of developing unpleasant symptoms	.76	—	—	—
PDAS 4	Concern for children's health and well-being	.56	—	—	—
PDAS 5	Fear of losing one's life	.90	—	—	—
PDAS 6	Fear of losing one's job	—	—	—	— †
PDAS 7	Inability to meet with friends	—	—	—	.76
PDAS 8	Fear of visiting a clinic	—	.41	—	—
PDAS 9	Fear of leaving the home environment	—	.54	—	—
PDAS 10	Fear of running out of food	—	—	.87	—
PDAS 11	Fear that no one will help	—	—	.49	—
PDAS 12	Fear of loss of fitness at home	—	—	—	.31
PDAS 13	Fear of infection at work	.37	.38 ‡	—	—
PDAS 14	Fear of shopping in a store	—	.96	—	—
PDAS 15	Fear of stock depletion in stores	—	—	.76	—
PDAS 16	Fear of going to the pharmacy	—	.75	.36 ‡	—
PDAS 17	Fear of cancelling life plans (e.g., travel)	—	—	—	.83

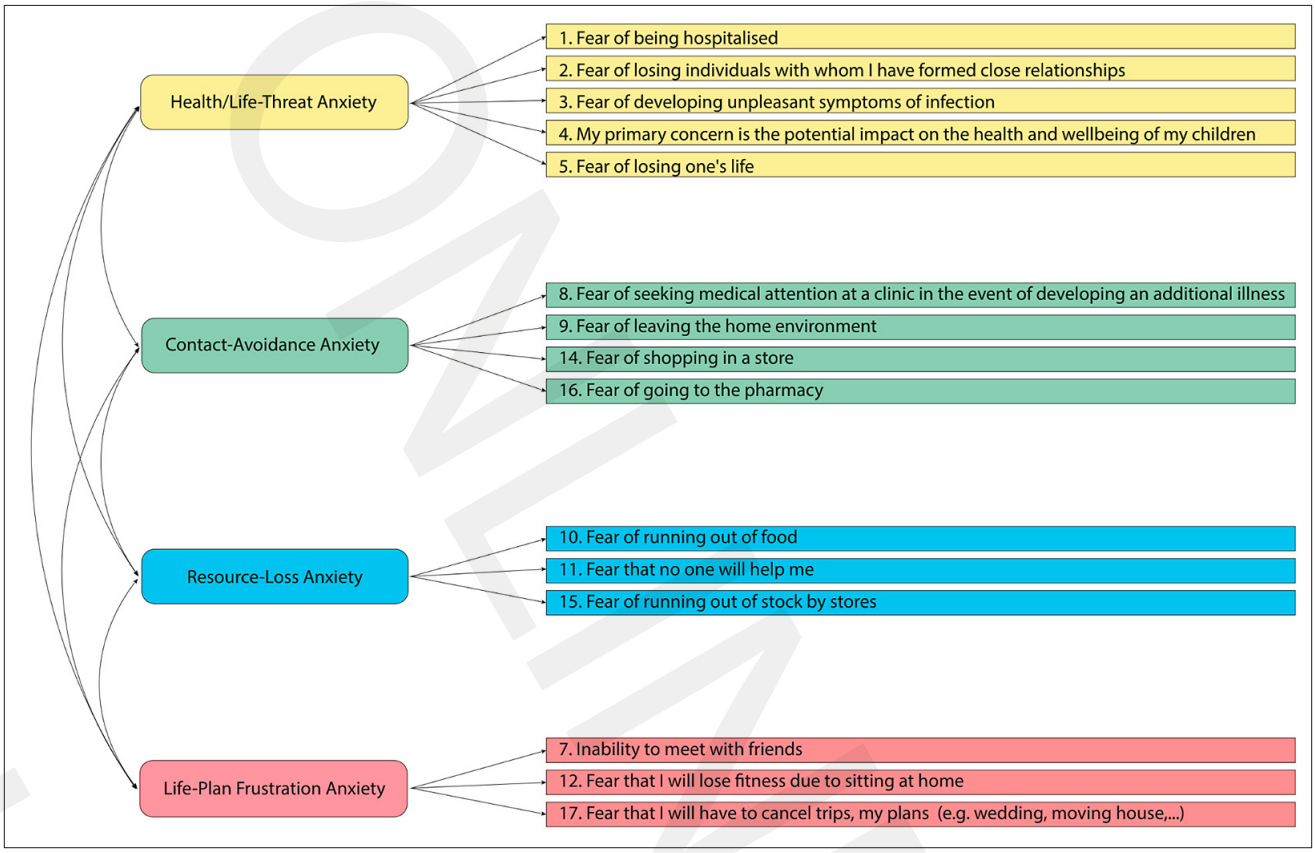

Figure 1. Exploratory Factor Analysis (EFA) of Pandemic Disease Anxiety Scale

Factor 1 (F1) – Health/Life-Threat Anxiety. The core defining items are PDAS 1, PDAS 2, PDAS 3, PDAS 4, and PDAS 5. In the split-sample exploratory analysis these items loaded most strongly on F1, with standardized loadings of.70,.76,.76,.56, and.90, respectively, confirming that direct concerns about health and survival remain the dominant content of this factor. This indicates that these items are strongly associated with the first dimension of pandemic disease fear, likely reflecting direct concerns about health and safety. This factor primarily considers the level of anxiety about one's own health, including concerns about the potential exacerbation of virus-related symptoms. Awareness of the symptoms and their potential consequences can also evoke a sense of fear about the possibility of losing one's life, and intrusive thoughts about what might be lost. It is also common to experience concerns for loved ones, including children, parents, and siblings. Frequently, such a condition also gives rise to ideas about negative, long-term consequences in the future (such as reduced fitness and feelings of loneliness). A high score indicates an exaggerated focus on the health of oneself and loved ones (Cronbach's α =.84; McDonald's ω =.85).

Factor 2 (F2) – Contact-Avoidance Anxiety. Primarily represented by items PDAS 8, PDAS 9, PDAS 14, and PDAS 16, with loadings of 0.41,.54,.96, and.75, respectively. These high loadings indicate that these items are critical to the second factor, which may have broader pandemic-related implications for society. This factor indicates the extent to which individuals are apprehensive about leaving their homes due to the potential risk of contracting the disease. It encompasses concerns about public spaces where there is a heightened likelihood of contact with a larger number of people. This is particularly relevant in settings where individuals who are unwell may be present, such as pharmacies, hospitals, and clinics. A high score suggests a proclivity towards social isolation due to concerns about infection (Cronbach's α =.86; McDonald's ω =.86).

Factor 3 (F3) – Resource-Loss Anxiety. Defined by items PDAS 10, PDAS 11, and PDAS 15, with loadings of.87,.49, and.76, respectively. The items suggest that the third factor captures fears related to economic concerns, social relationships, and potential disruptions caused by the pandemic virus. This factor refers to concerns about the continued existence of an individual due to the possibility of disease and pandemics. A person may experience difficulties in daily functioning due to the economic crisis and the inability to work. Additionally, there is a fear that stores will run out of food and necessities of life. There is also a concern about being unable to rely on support from others in everyday situations. A high score on this subscale indicates heightened concerns about coping with everyday situations (Cronbach's α =.80; McDonald's ω =.83).

Factor 4 (F4) – Life-Plan Frustration Anxiety. Comprises items PDAS 7, PDAS 12, and PDAS 17, with loadings of.76,.31, and.83, respectively. These loadings suggest that the fourth factor may be associated with anxieties related to isolation or the effects of the pandemic on mental health. The fourth factor pertains to concerns about the inability to execute life plans due to the impact of an infectious disease pandemic. Anxiety may result from difficulties in meeting basic needs that condition physical and mental health. These needs include exercise, healthy eating, proper relaxation, opportunities for

self-actualization, and activities that affect well-being and enhance self-esteem. Furthermore, an individual may be concerned about the inability to form and maintain healthy social relationships, which can impact the need for closeness, love, and social recognition. A high score indicates that an individual is experiencing heightened fears and frustration about the ability to maintain mental and physical health, form and maintain close relationships, and achieve life goals. (Cronbach's α =.61; McDonald's ω =.62; acceptable given only three items, but interpreted with caution).

The four-factor model was tested in the hold-out subsample (n = 473) using robust maximum likelihood estimation (MLR) with the NLMINB optimizer. The solution converged after 88 iterations and contained 51 free parameters. Robust fit indices met, or came close to, recommended APA benchmarks: $\chi^2(84)$ = 307.14; p <.001; robust CFI =.924 and robust TLI =.905 (≥.90); robust RMSEA =.080, 90 % CI [.070,.090] (≤.08), and SRMR =.059 (≤.08). Corresponding non-robust values were $\chi^2(84)$ = 349.93, CFI =.921, TLI =.901, and RMSEA =.082, 90% CI [.073,.091]. Standardized factor loadings ranged from.49 –.93, and latent-factor correlations were moderate (r =.36 –.60), indicating related but distinct dimensions. Taken together, these statistics support the adequacy of the proposed four-factor structure for the PDAS.

To examine construct validity, the total PDAS score was correlated with perceived stress (PSS-10) and chronological age. The PDAS demonstrated a small-to-moderate positive association with perceived stress, **r**(773) =.24, 95% CI [.17,.30]; p <.001, providing convergent evidence. In contrast, its correlation with age was near zero and non-significant, **r**(773) = –.06, 95% CI [–.13,.02]; p = .123, supporting discriminant validity.

CONCLUSIONS

The Pandemic Disease Anxiety Scale (PDAS-17) is a complementary tool that can be used in conjunction with existing questionnaires to assess fears and difficulties experienced due to the expansion of infectious disease. It provides an opportunity to evaluate the potential severity of anticipated problems related to relevant social factors.

All four discrete factors representing distinct dimensions of fear of the novel coronavirus factor loadings were significant, confirming that the items reliably measure the relevant constructs. These results validate the PDAS-17 as an effective tool for assessing anxiety related to the pandemic threat. This tool could be a valuable resource for rapidly assessing the most commonly experienced fears by patients, particularly in the context of ongoing pandemics. However, as the tool was initially tested in relation to the ongoing Covid-19 pandemic, it would be beneficial to conduct separate validation studies in other contexts, specifically in situations where other infectious diseases are a concern.

The scale offers an effective psychometric instrument for analysing the fears associated with a pandemic infectious disease situation. A swift diagnosis enables the implementation of appropriate therapeutic and preventive measures for individuals exhibiting heightened anxiety. The scale may therefore be a useful tool for the initial diagnosis of anxiety severity, particularly among individuals exposed to an enhanced risk, including those exhibiting various symptoms of mental health disorders (mental illness, depression, suicidal behaviour, personality disorders or anxiety disorder syndromes, obsessive-compulsive disorders, etc.). Nevertheless, further clinical research is required to achieve this goal. A substantial body of evidence from other researchers indicates that individuals with this disorder require immediate and targeted assistance in challenging circumstances, as the likelihood of suicidal behaviour and the severity of mental health conditions increase [25,31]. A brief assessment allows focusing on the most crucial dimensions of support. As research indicates, both disease-related concerns and social isolation may be significant factors that should be considered in interventions to mitigate the impact of the pandemic [32]. These aspects, among others, are the focus of the scale.

Limitations of the study. Firstly, this study did not include a comprehensive analysis of the individual's mental state, but focused instead on the basic fears experienced in a situation of a spreading infectious disease. Secondly, the participants in the study were drawn from the general population and no formal diagnoses of mental disorders (e.g. obsessive-compulsive disorder, anxiety) were made. It is also important to consider the possibility of subjectivity in the assessment of the participants and that some individuals may present their situation in a more favourable light. Considering the predominance of women in the study, one might assume that the sample is not entirely representative (purposive, non-random sampling). However, the analyses provided evidence that, at the level of model structure and factor loadings, there were no differences between men and women regarding the individual dimensions (scales) established through CFA. The measurement invariance analysis indicates that the factor structure (CONFIG level) is the same for both men and women; moreover, the factor loadings are also the same for men and women (METRIC level). Therefore, the obtained results can be generalized to the population of young adults. It is also important to conduct research in other age groups in order to generalize the results to the entire population. It would also be worthwhile to consider different variables that differentiate the studied group; however, due to the limited scope of the presented study, this will be the subject of future analyses. The results presented can be regarded as preliminary findings.

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