Article

Behaviour is the Key in a Pandemic: The Direct and Indirect Effects of COVID-19-Related Variables on Psychological Wellbeing

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Abstract

The aim of this study was to investigate the potential role of three COVID-19-related variables (i.e., risk perception, knowledge, and behaviour) on four indices of pandemic-related mental health (i.e., anxiety, depression, loneliness, and hopelessness). In total, 337 participants completed four self-report questionnaires: selected subscales of the World Health Organisation's COVID-19 Behavioural Insights Tool, UCLA Loneliness Scale, State-Trait Anxiety Inventory–Trait Scale, Center for Epidemiologic Studies Depression Scale, and Beck Hopelessness Scale. In addition to descriptive statistics and intercorrelations, structural equation modelling was used to compare three models of the potential role (predictor or moderator/mediator) that the three above-mentioned COVID-19-related variables could play in psychological wellbeing. The results showed high levels of psychological distress among the current sample. Generally, better knowledge of COVID-19 and engaging in protective behaviours were found to be related to lower levels of psychological distress, whereas increased risk perception was found to be associated with increased feelings of loneliness, anxiety, and depression. It was also found that behaviour mediated the effect of knowledge on psychological wellbeing, suggesting that while publicising information about

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COVID-19 remains necessary, providing the public with a means to engage in protective behaviours is central for promoting psychological wellbeing.

Introduction

In January 2020, the World Health Organisation (WHO) declared the coronavirus disease (COVID-19) outbreak as a public health emergency of international concern. In March 2020, the South African government declared a national state of disaster, allowing for the reallocation of resources and taking drastic pandemic-related prevention measures. Such measures included prohibition of in-person contact; mandatory social distancing; stay-at-home directives; quarantine; and halting of all nonessential services, such as schools, universities, restaurants, and retail outlets (South African Government Gazette, 2020). Despite being necessary to curtail the spread of the disease and protect the public, these prevention measures were highly disruptive and led to adverse social and economic consequences (e.g., loss of social support networks, economic decline, retrenchments, and increased unemployment) and negative mental health outcomes, particularly increased feelings of anxiety, loneliness, depression, and hopelessness (Tso & Park, 2021). However, despite the prevention efforts, the number of infections in South Africa has been steadily increasing (South African Department of Health, 2020) possibly because of the public's low level of compliance with the prevention guidelines.

A central determinant of people's willingness to cooperate and adopt health-protective behaviours is risk perception, which refers to a subjective appraisal of the likelihood of contracting COVID-19 (Dryhurst et al., 2020). Emerging evidence suggests that risk perception varies across countries and that appraisal of risk is significantly related to people's knowledge of disease severity, spread, and symptoms (Dryhurst et al., 2020). This association among risk perception, COVID-19-related knowledge, and engagement in pandemic-related precautionary behaviour has been investigated in several international surveys, yielding mixed findings. While some studies (e.g., Iorfa et al., 2020) suggest that risk perception mediates the association between COVID-19-related knowledge and precautionary behaviour, others (Li et al., 2020) have indicated that risk perception and knowledge independently predict compliance with prevention guidelines. Hence, the aim of this

study is to examine the potential role that these three COVID-19-related variables (i.e., risk perception, knowledge, and behaviour) play in psychological wellbeing.

Method

Participants

A cross-sectional research design was adopted in this study. All participants ($N = 337$) were randomly sampled young adults enrolled in undergraduate studies at a university in the province of Western Cape, South Africa. Most of the participants were female (77.2%), with a mean age of 21.95 years ($SD = 4.7$).

Instruments

All the participants completed selected subscales of the WHO COVID-19 Behavioural Insights Tool (WHO, 2020), UCLA Loneliness Scale (UCLA-LS; Russell et al., 1980), State-Trait Anxiety Inventory–Trait Scale (STAI-T; Spielberger, 1988), Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977), and Beck Hopelessness Scale (BHS; Beck et al., 1974), as well as a demographic questionnaire containing items pertaining to age, gender, and area of residence. The selected subscales of the WHO COVID-19 Behavioural Insights Tool were Knowledge, COVID-19 Risk Perception and Protective Behaviours.

The Knowledge subscale measures the extent to which participants are knowledgeable about the symptoms of COVID-19 (10 items) and the treatment (2 items) thereof. The Risk Perception subscale (3 items) measures the extent to which participants perceive themselves to be at risk of contracting the virus. The Protective Behaviours subscale (16 items) assesses the extent to which participants regularly engage in behaviours that prevents infection (such as wearing a face mask).

The UCLA-LS is a 20-item measure of general loneliness and degree of satisfaction with one's social network. This scale consists of one total loneliness scale and three subscales corresponding to three self-related facets of loneliness and social connectedness: loneliness; relational connectedness, which reflects satisfaction of the need for close friendships; and collective connectedness, which reflects satisfaction of the need to belong to a meaningful group. Responses are scored on a 4-point Likert scale, ranging from 1 (*I often feel this way*) to 4 (*I never feel this way*). The UCLA-LS demonstrated good internal consistency reliability with Cronbach alpha values ranging from .94 to .96 (e.g. Doğan et al., 2011).

The STAI-T is a 20-item measure of trait anxiety. The trait anxiety items in this measure include "I worry too much over something that really doesn't

matter" and "I am content; I am a steady person." All items are rated on a 4-point scale, ranging from 1 (*Almost never*) to 4 (*Almost always*). The internal consistency coefficients for this scale were found to range from .84 to .94 (e.g. Hashim et al., 2018).

The CES-D is a 10-item depression screening tool that includes three items on depression, five items on somatic symptoms, and two items on positive affect. Responses to each item are scored on a 4-point scale, ranging from 0 (*Rarely or none of the time*) to 3 (*All of the time*). The internal consistency coefficients for this scale were found to range from .70 to .90 (e.g. González et al., 2017).

The BHS is a 20-item true/false inventory that assesses the degree to which individuals' cognitive schemata are associated with pessimistic expectations (e.g., "I don't expect to get what I really want," "My future seems dark to me"). The internal consistency for this scale has been reported to be .93, along with a concurrent validity of .74 with clinical ratings of hopelessness and .60 with other scales of hopelessness (Beck et al., 1974).

Procedure

An electronic survey comprising the above instruments was generated using Google Forms and distributed during the period of national lockdown in South Africa (from March to June 2020). A reminder was sent to all the participants twice monthly over the 4-month period.

Data analysis

IBM SPSS Statistics for Windows version 26 (IBM Corp., Armonk, NY, USA) was used to determine descriptive statistics and intercorrelations between study variables as well as reliabilities. Structural equation modelling with IBM SPSS Amos (version 26; IBM Corp.) was used to (a) compare three models of the potential role (predictor or moderator/mediator) that the three abovementioned COVID-19-related variables could play in psychological wellbeing and (b) determine the direct and indirect effects of the predictor variable as well as bootstrapping of confidence levels and *p*-values. In contemporary analysis, indirect effects are regarded as a measure of mediation, and their value indicates the amount of mediation. In addition, confidence intervals are used to determine whether the indirect effects are different from zero. If zero does not fall within the confidence interval, the indirect effects are said to be significant (Kenny, 2018). With multiple mediators, indirect effects represent the total indirect effects of the predictor via all mediators. To estimate the specific indirect effects of knowledge for each mediator separately, we used the user-defined estimand function in Amos.

It has been indicated in the literature (e.g., Iorfa et al., 2020) that the three abovementioned COVID-19-related variables may be regarded as predictors or,

alternatively, as mediators or moderators. Therefore, we compared the following three statistical models: (a) COVID-19 knowledge as a predictor and protective behaviour and risk perception as moderators or mediators, with psychological wellbeing as an outcome variable; (b) knowledge and behaviour as predictors and risk perception as a moderator or mediator, with psychological wellbeing as an outcome variable; and (c) risk perception as a predictor and knowledge and behaviour as moderators or mediators, with psychological wellbeing as an outcome variable. The models also included one latent variable (i.e., psychological wellbeing) that was inferred from the depression, anxiety, hopelessness, and loneliness scores.

The extent to which a hypothesised model fits the observed data is measured using the chi-square statistic (χ^2), which tests the null hypothesis of a perfect fit. Kline (2005) suggested that, in addition to the model χ^2, at a minimum, the following indices should be reported: root-mean-square error of approximation (RMSEA, best if close to .08 or less) and comparative fit index (CFI, best if close to .90 or greater). Additional indices include the goodness-of-fit index (GFI, best if close to .95 or greater) and Tucker–Lewis index (TLI, best if close to .95 or greater; Hu & Bentler, 1999). In addition, Akaike information criterion (AIC), which is specifically used for model comparisons was also included in the fit indices. Notably, lower AIC values are generally associated with a better model fit.

The moderating effect was examined by testing the direct effects of the product of the predictor and presumed mediator (predictor × mediator). To avoid multicollinearity and aid the interpretation of interaction effects, the deviation scores (score minus mean) of the predictor and presumed moderator were used in the calculation of the product term (Cohen et al., 2013).

Ethics

Ethical approval for this study was obtained from the Humanities and Social Sciences Research Committee of University of the Western Cape. The survey was completed anonymously, and all the participants provided informed consent prior to accessing the survey. Given the context of COVID-19 and the nature of the questionnaire, the participants were provided with the contact details of the South African Depression and Anxiety Group and the Centre for Student Support Services in case they experienced any psychological distress as a result of completing the questionnaire.

Results

Descriptive statistics, intercorrelations, and reliabilities (alpha coefficient) are reported in Table 1. Given the number of correlations computed we used the Benjamini-Hochberg method (Benjamini & Hochberg, 1995) to determine

Table 1. Intercorrelations, descriptive statistics, and reliabilities of variables.

Variable	1	2	3	4	5	6	7
1. Loneliness	–	.014	.007	.003		.043	.019
2. Anxiety	.69***	–	.005	.003	.019	.045	.006
3. Hopelessness	.55***	.62***	–	.002	.045	.002	
4. Depression	.58***	.79***	.56***	–			.005
5. Knowledge	−.08	−.13*	−.11*	−.07	–	.012	
6. Behaviour	−.11*	−.11*	−.17**	−.06	.14**	–	
7. Risk perception	.13*	.16**	.07	.16**	.03	−.06	–
M	49.1	48.1	4.7	27.5	9.3	52.2	8.4
SD	11.6	10.5	4.4	13.4	2.1	5.4	2.1
Alpha	.92	.88	.89	.92	.64	.73	.57

$*p < .05$, $**p < .01$, and $***p < .001$.

whether the coefficients remained significant (False Discovery Rate $= .05$) after adjusting for multiple testing. The Benjamini-Hochberg adjusted p-values are reported above the diagonal and the correlation coefficients below the diagonal.

The means reported for the psychological wellbeing indices (loneliness: $M = 49.1$, $SD = 11.6$; anxiety: $M = 48.1$, $SD = 10.5$; hopelessness: $M = 4.7$, $SD = 4.4$; depression: $M = 27.5$, $SD = 13.4$) were found to be higher than the mean scores reported for these scales in other contexts (i.e., loneliness, e.g. Topaloglu, 2017: $M = 36$; anxiety, e.g. Yang et al., 2017: $M = 43.3$, $SD = 9.2$; hopelessness, e.g. Lotfi-Kashani et al., 2018: range for intervention and control groups: $M = 1.8$–2.4, $SD = .36$–.43; depression, e.g. Giuntella et al., 2021: $M = 14.6$, $SD = 9.6$).

In terms of reliability, the indices of psychological wellbeing demonstrated satisfactory reliability ($\alpha = .88$ to .92) and the knowledge and behaviour scales demonstrated acceptable reliability. However, the three-item risk perception scale demonstrated low reliability.

With respect to the intercorrelations between the variables, the Benajmini-Hochberg adjusted p values, reported above the diagonal, reflect that all the significant coefficients remain significant after accounting for multiple testing. The intercorrelations between the indices of psychological wellbeing were all highly significant (r (335) $= .55$ to .79, $p < .001$). Knowledge of COVID-19 symptoms was negatively related to anxiety (r (335) $= −.13$, $p = .014$) and hopelessness (r (335) $= −.11$, $p = .041$). Protective behaviour was negatively related to loneliness (r (335) $= −.11$, $p = .043$), anxiety (r (335) $= −.11$, $p = .042$), and hopelessness (r (335) $= −.17$, $p = .001$). Risk perception was positively related to loneliness (r (335) $= .13$, $p = .015$), anxiety (r (335) $= .16$, $p = .003$), and depression (r (335) $= .16$, $p = .003$).

The three models that were compared are shown in Figure 1. All three models included two product terms (predictor × presumed moderator) and a latent
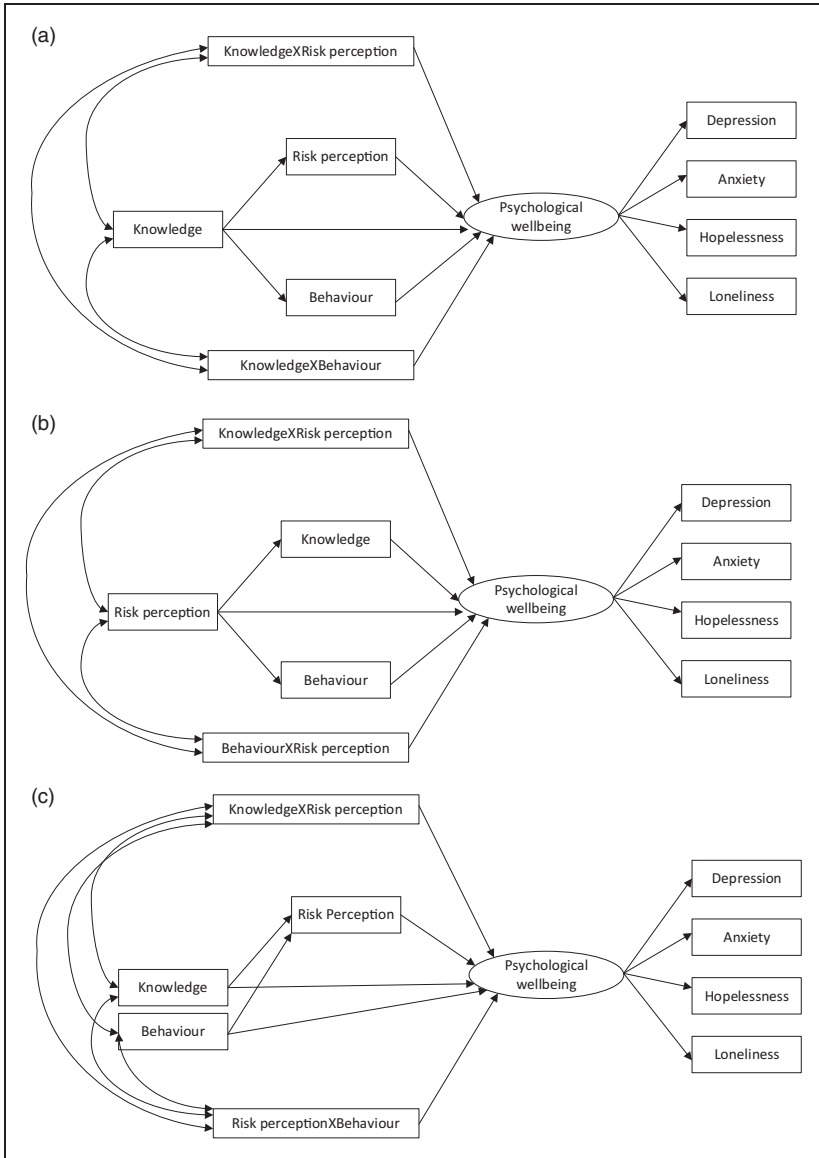
Figure 1. Three models of the interrelationship between COVID-19-related variables and psychological wellbeing. Panel A: knowledge as a predictor, risk perception and behaviour as mediators or moderators, and psychological wellbeing as an outcome. Rectangles represent observed variables, and the ellipse represents a latent variable. Panel B: risk perception as a predictor, knowledge and behaviour as mediators or moderators, and psychological wellbeing as an outcome. Panel C: knowledge and behaviour as predictors, risk perception as a mediator or moderator, and psychological wellbeing as an outcome.

Table 2. Comparison of fit indices for the three models regarding the interrelationship between COVID-19-related variables and psychological wellbeing.

	χ^2		RMSEA		TLI	GFI	CFI	AIC	ΔAIC
	Value (df)	p	Value	95% CI					
					Best fit indicator				
		ns	$<.08$		$>.95$	$>.95$	$>.90$	Lower values	
Knowledge as predictor	32.58 (21)	.051	.04	[.00, .07]	.97	.98	.99	80.58	–
Knowledge and behaviour as predictor	30.35 (18)	.034	.05	[.01, .07]	.97	.98	.98	84.35	−3.77
Risk perception as predictor	40.24 (21)	.007	.05	[.03, .08]	.96	.97	.98	88.24	−3.89

Note. χ^2 = chi squared; RMSEA = root-mean-square error of approximation; TLI = Tucker–Lewis index; GFI = goodness-of-fit index; AIC = Akaike information criterion; 95% CI = 95% confidence interval; ns = not statistically significant.

variable (psychological wellbeing), inferred from the scores of the UCLA-LS, STAI-T, CES-D, and BHS. In the first model, knowledge is regarded as a predictor, psychological wellbeing as an outcome, and behaviour and risk perception as mediators. In the second model, knowledge and behaviour are regarded as predictors, risk perception as a mediator, and psychological wellbeing as an outcome. Finally, in the third model, risk perception is conceptualised as a predictor whose relationship with psychological wellbeing is mediated by knowledge and behaviour.

Table 2 shows the results of comparing the three models.

Table 2 indicates that all three models demonstrated acceptable fit indices (RMSEA < .08, TLI > .95, GFI > .95, and CFI > .90). However, the first model with knowledge as predictor, showed the lowest value for the model comparison index (AIC = 80.58). As such, we decided to use knowledge as a predictor, behaviour and risk as mediators, and psychological wellbeing as an outcome in the calculation of direct and indirect effects. These results are reported in Table 3.

Table 3 shows that the regression loadings of the psychological indices on the latent variable of psychological wellbeing ranged from .66 to .95 and were all significant ($p < .001$). It also shows no moderating effects for behaviour and risk perception and indicates significant direct effects (negative) for knowledge ($\beta = -.12$, $p = .019$) and risk perception (positive, $\beta = .17$, $p = .011$). In both instances, zero was outside the bootstrapped confidence intervals.

Table 3 further indicates that, initially, the indirect effects of knowledge (which is taken as a measure of mediation) were not significant ($\beta = -.01$, $p = .380$). However, it should be noted that the indirect effects of the two

Table 3. Direct and indirect effects of COVID-19-related variables on psychological wellbeing.

Variable	Beta	SE	β	95% CI	p
Direct effects					
Knowledge	−.49	.23	−.12	[−.23, −.03]	.019
Risk perception	.64	.23	.17	[.07, .24]	.011
Behaviour	−.14	.08	−.09	[−.17, .01]	.157
Knowledge × risk perception	.07	.11	.03	[−.05, .13]	.475
Knowledge × behaviour	.002	.04	.003	[−.09, .10]	.976
Indirect effects					
Knowledge[a]	−.03	.05	−.01	[−.03, .01]	.380
Knowledge via behaviour[b]	.02	.04	−.013	[−.18, −.001]	.047
Knowledge via risk perception[c]	−.05	.04	.004	[-.01, .02]	.538

Note: [a]Total indirect effects: knowledge as a predictor and behaviour and risk perception as joint mediators.
[b]Specific indirect effects: knowledge as a predictor and behaviour as a mediator.
[c]Specific indirect effects: knowledge as a predictor and risk perception as a mediator.

mediators were opposite in sign (behaviour = negative, risk perception = positive). This is a case of what Kenny (2018) calls opposing mediation, in which two indirect effects work in opposite directions and the sum of those indirect effects is close to zero. Therefore, the indirect effects of knowledge via behaviour and risk perception were considered separately with user-defined estimands. As shown in Table 3, only the indirect effects of knowledge via behaviour were significant ($\beta = -.02$, $p = .020$), demonstrating a mediating effect for behaviour in terms of the relationship between knowledge and psychological wellbeing.

Discussion

The aim of this study was to investigate the potential role of three COVID-19-related variables (i.e., risk perception, knowledge, and behaviour) on four indices of pandemic-related mental health (i.e., anxiety, depression, loneliness, and hopelessness). Several important findings were obtained from this study. First, the extent of psychological distress reported in the current sample was very high. The levels of anxiety, hopelessness, depression, and loneliness exceeded those documented in the existing literature in other contexts (e.g. Giuntella et al., 2021), which may be related to specific features of the South African society. This COVID-19 outbreak is occurring against the backdrop of disease epidemics such as HIV/AIDS, tuberculosis and diabetes (Berkowitz et al., 2018). This may aggravate the levels of anxiety with regard to the physical health impact of COVID-19 infection and, for people living in adverse circumstances, contribute to a sense of hopelessness and despondency stemming from their feeling of being

unable to protect themselves. Nearly a quarter of the South African population live in township settings that are characterised by high population density and limited access to social services, such as clean running water (Bulled & Singer, 2020). Such pre-existing social conditions along with the added burdens of the current pandemic, such as economic decline and downsizing, have led to an increase in poverty, unemployment, and malnutrition (Egan, 2020). Difficulty meeting basic needs as well as social circumstances that make following COVID-19 prevention guidelines nearly impossible could aggravate the levels of anxiety and hopelessness and lead to depression.

Several pandemic-related preventative measures, such as quarantine and stay-at-home directives, have contributed to isolation from broad social support networks. While this can be circumvented using digital technology, access to online and virtual modes of communication is not available to a significant portion of the South African population because of the lack of internet access and limited affordability of smartphones (Oyedemi & Mogano, 2018). It is, therefore, expected that many people will experience increased feelings of social isolation and disconnection from significant others, which could aggravate feelings of loneliness. It should also be noted that the reported rates of gender-based violence have increased in the country during the period of national lockdown (McCain, 2020). Generally, living with a potential perpetrator in a confined setting for a prolonged period of time and without direct access to broader social support networks could contribute to a heightened sense of threat, loneliness, and depression.

The results of this study also showed that greater knowledge of COVID-19 is associated with lower levels of anxiety and hopelessness and that being able to engage in protective behaviour is related to reduced feelings of loneliness, anxiety, and hopelessness. In contrast, greater risk perception has been found to be associated with increased feelings of loneliness, anxiety, and depression. These findings are consistent with studies suggesting that increased awareness of transmission modes and preventative measures can foster a sense of agency and, hence, decrease the feelings of anxiety and hopelessness (Jungmann & Witthöft, 2020). Furthermore, anxiety is a significant predictor of hopelessness (e.g., Carretta et al., 2014), which could also account for the association. It is probable that engaging in preventative measures and being aware that this contributes to the safety of loved ones can make the experience of social isolation more bearable and thereby reduce feelings of loneliness. It should be noted that the finding that greater risk perception is associated with increased psychological distress is consistent with the literature (e.g. Dryhurst et al., 2020). More direct experiences with the virus can heighten the sense of threat associated with the pandemic, contributing to increased levels of anxiety. Higher risk perception also leads to greater engagement in protective behaviour, such as social distancing and self-isolation, which could contribute to feelings of loneliness and depression (Dryhurst et al., 2020).

While the literature (e.g. Iorfa et al., 2020) supports the conceptualisation of knowledge, behaviour, and risk perception as either predictors or mediators, in this study, we found that the model in which knowledge is regarded as a predictor was only marginally a better fit than the other models. When the two mediators of behaviour and risk perception were considered together, an opposing mediation effect was observed. Thus, it was concluded that the overall indirect effects of knowledge on psychological wellbeing are not significant. When considered separately, only the indirect effects via behaviour were found to be significant and not the indirect effects via risk perception. Thus, it was concluded that behaviour mediates the relationship between knowledge and psychological wellbeing. While this does not suggest causality, it is reasonable to speculate that knowledge about COVID-19, including its symptoms, modes of transmission, and prevention methods, must be translated into protective actions to have an influence on psychological wellbeing. This finding is in line with studies (e.g., Parletta et al., 2016) that have underscored the importance of health behaviour in promoting psychological wellbeing. This finding also has implications for mental health in that it suggests that while publicising information about COVID-19 remains necessary, providing the public with a means to engage in protective behaviour (e.g., access to masks, clean running water, and sanitisers) may be more important in promoting psychological wellbeing. However, this is not to understate the importance of promoting knowledge about COVID-19, since the direct effects of knowledge on wellbeing was also significant. This finding suggests that people who are armed with sufficient knowledge about symptoms in all likelihood feel more empowered and this would impact their mental health positively.

Limitations

This study relied on self-report measures and used a cross-sectional design, precluding casual inferences. Nevertheless, the findings obtained herein are consistent with the international literature. The participants of this study were university students, which may limit the generalisability of the findings. Hence, future studies should employ a more diverse sample. The study was also conducted over a 4-month period. In this regard, participants that completed the survey early in the pandemic would possible have less knowledge of the pandemic than those that completed it at a later period.

Conclusion

To our knowledge, this is the first study investigating the association between three COVID-19-related variables (i.e., risk perception, knowledge, and behaviour) and the levels of psychological distress in South Africa. We believe that the findings of this study add to the growing literature on the mental health impact of COVID-19 in developing contexts and suggest important targets for intervention.

Compliance With Ethical Standards

All procedures performed in studies involving human participants were in accordance with the ethical standards of the [Humanities and Social Sciences Research Ethics committee] and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Statement of Each Individual Author's Contributions

Both authors were involved in the conception and design of the study, and collection of data. The first author contributed to the first draft of the introduction and discussion sections and the critical review thereof. The second author was responsible for the analysis and interpretation of data as well as drafting of the methods and results sections.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

Informed Consent

Informed consent was obtained from all participants included in the study.

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