Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Short communication

Impact of COVID-19 predicts perceived risk more strongly than known demographic risk factors

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ABSTRACT

Objective: To identify the factors associated with perceived COVID-19 risk among people living in the US.
Methods: A cross-sectional representative sample of 485 US residents was collected in mid-April 2020. Participants were asked about (a) perceptions of COVID-19 risk, (b) demographic factors known to be associated with increased COVID-19 risk, and (c) the impact of COVID-19 on different life domains. We used a three-step hierarchical linear regression model to assess the differential contribution of the factors listed above on perceived COVID-19 risk.
Results: The final model accounted for 16% of variability in perceived risk, $F(18,458) = 4.8$, $p < .001$. Participants who were White reported twice as much perceived risk as participants of color ($B = -2.1$, 95% CI[−3.4,-0.8]. Higher perceived risk was observed among those who reported a negative impact of the pandemic on their sleep ($B = 1.5$, 95% CI[0.8,2.1]) or work ($B = 0.7$, 95%CI[0.1,1.3]). The number of cases per capita in their state of residence, age, or proximity to someone with a COVID-19 diagnosis were not found to meaningfully predict perceived risk.
Conclusions: Perceived risk was not found to be associated with known demographic risk factors, except that the effect of race/ethnicity was in the opposite direction of existing evidence. Perception of COVID-19 risk was associated with the perceived personal impact of the pandemic.

By April 16, 2020, COVID-19-related deaths reached 130,885 worldwide. Instated preventive measures (e.g., face masks) represent significant behavior changes [1]. Protection motivation theory [2] suggests these measures are more likely to be adopted if they are perceived as necessary. Thus, perceived risk of COVID-19 likely predicts adoption of risk-minimization behaviors [3].

We examined demographic factors theorized to predict perceived risk of COVID-19, including those associated with (a) increased infection risk and (b) self-reported personal impact of COVID-19 on daily life. Demographic factors increasing risk of COVID-19 include being older, Black, a resident of a state with high concentrations of cases, and living in a larger household [4]. We anticipated that participant's reports of personal impact of COVID-19 (e.g., effect of the pandemic on work) would also predict perceived risk [5]. The scope of the pandemic makes understanding perceived COVID-19 risk challenging and pressing.

1. Method

1.1. Participants

A nationally representative sample of participants was recruited through Prolific (prolific.co); 501 participants completed the online survey between April 14 and April 16, 2020. Sixteen participants (3.2%) did not pass attention checks and were excluded; the final sample

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Table 1
Means and standard deviations for variables of interest.

	Gender			Race/Ethnicity		
	Women(n = 242)	Men (n = 242)	TGD (n = 11)	Participants of Color (n = 136)	White (n = 348)	All (n = 485)
	M ± *SD* n (%)	*M* ± *SD* n (%)	*M* ± *SD* n (%)	*M* ± *SD* n (%)	*M* ± *SD* n (%)	*M* ± *SD* n (%)
Age	45.6 ± 16.1$_a$	44.2 ± 15.8$_a$	34.6 ± 13.6$_b$	39.6 ± 15.0$_a$	46.7 ± 15.9$_b$	44.7 ± 16.0
Cohabiting	2.8 ± 1.5	2.8 ± 1.3	2.8 ± 1.0	3.0 ± 1.6	2.7 ± 1.3	2.8 ± 1.4
Cases/Cap.	0.002 ± 0.003	0.002 ± 0.003	0.002 ± 0.004	0.002 ± 0.003	0.002 ± 0.003	0.002 ± 0.003
Fin. Status	2.1 ± 1.1$_a$	1.8 ± 1.0$_b$	2.0 ± 1.2$_a$	2.1 ± 1.0	1.9 ± 1.0	2.0 ± 1.0
Impact						
Soc. Relat.	3.7 ± 1.0	3.8 ± 0.9	3.8 ± 1.0	3.7 ± 1.0	3.8 ± 0.9	3.8 ± 0.9
Rom. Relat.	3.2 ± 0.9	3.3 ± 1.0	3.3 ± 1.1	3.3 ± 1.0	3.3 ± 0.9	3.3 ± 1.0
Sleep	3.5 ± 1.1a	3.2 ± 1.0b	2.9 ± 0.9	3.3 ± 1.1	3.4 ± 1.0	3.3 ± 1.0
Physical	3.5 ± 1.1	3.5 ± 1.1	3.3 ± 1.3	3.6 ± 1.1	3.5 ± 1.1	3.5 ± 1.1
Work	3.6 ± 1.0	3.6 ± 1.0	3.9 ± 1.1	3.7 ± 1.1	3.6 ± 1.0	3.6 ± 1.0
Diagnoses						
Self	4 (1.7%)	2 (0.9%)	0 (0.0%)	0 (0.0%)	6 (1.7%)	6 (1.2%)
SO	4 (1.7%)	2 (0.9%)	0 (0.0%)	0 (0.0%)	6 (1.7%)	6 (1.2%)
Family	3 (1.2%)$_a$	3 (1.3%)$_a$	1 (10.0%)$_b$	2 (1.5%)	5 (1.4%)	7 (1.4%)
Ext. Family	13 (5.4%)	11 (4.7%)	0 (0.0%)	8 (5.9%)	16 (4.6%)	24 (5.0%)
Friend	24 (9.9%)	16 (6.9%)	2 (20.0%)	11 (8.1%)	31 (8.9%)	42 (8.7%)
Coworker	5 (2.1%)	8 (3.4%)	0 (0.0%)	4 (2.9%)	9 (2.6%)	13 (2.7%)

Note: Gender: TGD = participants who identified as transgender or gender diverse. Values within the same subcategory (Gender and Race/Ethnicity) and row not sharing a coefficient are significantly different at $p < .05$. Values without a subscript were not significantly different within that subcategory. Comparisons involving Gender: TGD should be interpreted cautiously given the small number of participants who identified as TGD. Cases per Capita is presented to the first significant digit for clarity.
Cases/Cap = cases per capita; Fin. Status = financial status; Soc. Relat. = social relationships; Rom. Relat. = romantic relationships; SO = significant other; Ext. Family = extended family.

included 485 participants. Using data from the US Census Bureau (www.census.gov), Prolific automatically stratified recruitment across age, gender, and race to align with the national population. Chi square tests indicated that there were no significant differences between the US population and the study sample in age, $\chi^2(5) = 2.147$, $p = .828$, or gender, $\chi^2(1) = 0.012$, $p = .911$; however, the proportion of Native American/Native Hawaiians in the sample was less than that of the US population, $\chi^2(3) = 40.873$, $p < .001$. On average, participants were 44.7 years old ($SD = 16.0$); 232 (47.8%) were men, 242 (49.9%) were women, and 11 (2.3%) were transgender or gender diverse (TGD). Most respondents ($n = 405$, 83.5%) identified as heterosexual, 19 (3.9%) as gay/lesbian, and 40 (8.3%) as bisexual. Half ($n = 264$, 54.4%) lived with a spouse or partner, and there was an average of 2.81 ($SD = 1.4$) people in each household. Subjective socioeconomic status[6] was measured using a single item with three options (lower, middle, or upper). This single-item measurement of subjective SES has seen some use in other studies by the first author of this study [7,8], but has not yet been validated. About one-fifth of participants responded lower ($n = 104$, 21.4%), 342 (70.5%) as middle, and 35 (7.2%) as upper. Most respondents ($n = 348$, 71.8%) were White, with smaller proportions of Black/African American ($n = 62$, 12.8%), Asian ($n = 33$, 6.8%), Hispanic ($n = 28$, 5.8%), and Native American/Native Hawaiian ($n = 4$, 0.8%) participants.

1.2. Procedures

This study was approved by the Institutional Review Board at the first author's home institution. Participants provided informed consent through Qualtrics, completed the survey, and were paid $2.64 for their time.

1.3. Measures

1.3.1. Perceived risk

Perceived risk of COVID-19 was assessed with the 8-item Perceived Risk of HIV Scale [9], which was adapted by replacing "HIV" with "COVID-19" for all items. For example, the item "I worry about getting infected with HIV" was modified to "I worry about getting infected with COVID-19." Higher scores indicate greater risk perception.

1.3.2. Perceived impact

Participants rated how COVID-19 had impacted several aspects of their lives on a 1 (very positive impact) to 5 (very negative impact) scale. Questions assessed the impact of COVID-19 on social relationships, romantic relationships, sleep, physical activity, and work.

1.3.3. Financial status

Financial status, as distinct from subjective SES [6], was measured by asking "without giving exact dollars, how would you describe your household's financial situation right now?", This single-item, plain language approach to assessing financial status is intended to capture variability associated with regional differences in cost of living and family size [10], has been demonstrated to have a higher response rate than direct income assessment [11], and has seen wide use [12–16].

1.3.4. Proximity to diagnosis

Participants reported if they had been diagnosed with COVID-19 and if others in their family or social circle had been diagnosed. Six yes or no questions probed if they, a significant other, immediate family member, extended family member, friend, or coworker had been diagnosed.

1.3.5. Geographic data

Participants provided the first three digits of their ZIP code to connect responses to data on the pandemic. Cases per capita for each state was calculated by dividing the number of COVID-19 cases in each state [17] by state population [18].

1.4. Analytic plan

Effects of gender and race/ethnicity on perceived COVID-19 risk were compared using ANOVAs. If main effects were not observed, variables were either dichotomized or removed from the final model. A

Table 2
Predictors of perceived COVID-19 risk.

Step and variable		*B*	*β*	*p*	LLCI	ULCI	R^2	ΔR^2
1		$F(6,470) = 2.8$, $p = .018$					0.03	0.03
	Age	-0.0	-0.0	0.48	-0.1	0.0		
	GenderM	-0.9	-0.1	0.12	-2.1	0.3		
	GenderTGD	-0.4	-0.0	0.82	-4.4	3.5		
	Race/ethnicity	-2.2	-0.6	< 0.001	-3.6	-0.9		
	Cohabiting	0.2	0.0	0.36	-0.2	0.6		
	Cases/Cap	226.4	0.1	0.04	10.0	442.8		
2		$F(13,463) = 2.4$, $p = .004$					0.06	0.03
	Age	-0.0	-0.04	0.45	-0.1	0.0		
	GenderM	-0.9	-0.1	0.16	-2.1	0.3		
	GenderTGD	-0.5	-0.0	0.81	-4.5	3.5		
	Race/ethnicity	-2.1	-0.2	< 0.001	-3.5	-0.8		
	Cohabiting	0.2	0.0	0.47	-0.3	0.6		
	Cases/Cap	224.6	0.1	0.04	6.2	443.0		
	Fin. Status	-0.7	-0.1	0.03	-1.3	-0.1		
	Diagnoses							
	Self	6.7	0.1	0.07	-0.5	13.9		
	SO	-2.8	-0.1	0.45	-9.9	4.4		
	Family	-1.6	-0.0	0.54	-6.6	3.4		
	Ext. Family	-0.2	-0.0	0.87	-3.0	2.6		
	Friend	2.0	0.1	0.07	-0.2	4.1		
	Coworker	-1.1	-0.0	0.58	-4.9	2.8		
3		$F(18,458) = 4.8$, $p < .001$					0.16	0.10
	Age	0.00	-0.0	0.88	-0.0	0.0		
	GenderM	-0.4	-0.0	0.53	-1.5	0.8		
	GenderTGD	0.2	0.0	0.91	-3.6	4.0		
	Race/ethnicity	-2.1	-0.1	< 0.001	-3.4	-0.8		
	Cohabiting	0.2	0.1	0.30	-0.2	0.6		
	Cases/Cap	150.0	0.1	0.16	-61.0	361.0		
	Fin. Status	-0.5	-0.1	0.13	-1.1	0.2		
	Diagnoses							
	Self	4.8	0.1	0.17	-2.1	11.8		
	SO	-2.7	-0.1	0.44	-9.5	4.2		
	Family	-0.1	0.0	0.96	-5.0	4.7		
	Ext. Family	-0.7	-0.0	0.61	-3.4	2.0		
	Friend	1.42	0.06	0.18	-0.7	3.5		
	Coworker	-1.96	-0.05	0.30	-5.6	1.7		
	Impact							
	Soc. Relat.	0.58	0.08	0.09	-0.09	1.24		
	Rom. Relat	-0.35	-0.05	0.29	-0.99	0.30		
	Sleep	1.45	0.23	< 0.001	0.82	2.08		
	Physical	0.46	0.08	0.10	-0.09	1.01		
	Work	0.69	0.10	0.03	0.07	1.30		

Note: GenderM coded as 0 = women and 1 = men, GenderTGD as men or women = 0, TGD = 1. Cases/Cap = cases per capita; Fin. Status = financial status; Soc. Relat. = social relationships; Rom. Relat. = romantic relationships; SO = significant other; Ext. Family = extended family.

three-step hierarchical linear regression was then estimated, and regression diagnostics were assessed to determine if the results were interpretable. All diagnostic values were within established guidelines.

2. Results

Six (1.23%) participants reported being diagnosed with COVID-19, six (1.2%) reported their significant other had been diagnosed, seven (1.4%) indicated an immediate family member had been diagnosed, and 24 (5.0%) noted an extended family member had been diagnosed. In addition, 42 participants (8.7%) reported COVID-19 diagnoses among friends, and 13 (2.7%) reported diagnoses among coworkers.

Perceived risk of COVID-19 was normally distributed, with $M = 26.2$, $SD = 6.6$, skewness = −0.3 (SE skew = 0.1), kurtosis = 0.008 (SE kurtosis = 0.2). The scale had an acceptable alpha of 0.85. There was no main effect of race/ethnicity on perceived risk ($F(6,475) = 2.1$, $p = .05$); however, post-hoc tests revealed large differences between White participants (M = 26.8, SD = 6.5) and participants of any other race/ethnicity (M = 24.9, SD = 6.6,). Accordingly, race/ethnicity was dichotomized into White (0) and All Other (1).

With regard to financial status, 53 respondents (11.1%) reported "Not enough money to pay the bills," 137 (28.9%) said they had "Enough to pay the bills, but have had to cut back," 162 (34.2%) reported "Enough to pay the bills without cutting back," and 120 (25.2%) said they had "Enough money for extras."

Two differences between men and women emerged, with men reporting higher levels of financial resources than women, and women reporting greater impact of COVID-19 on sleep and financial resources. See Table 1 for detailed summary statistics; note that comparisons involving the TGD group should be interpreted cautiously given the small number of TGD participants.

A three-step hierarchical linear regression predicting perceived risk was estimated (see Table 2). In the first step, demographic and geographic risk factors were added. In the second step, proximity to people diagnosed with COVID-19 was added. In the third step, perceived impact of COVID-19 and/or preventative measures were added. The final model predicted 16% of the variability in perceived risk; race/ethnicity, work, and sleep were statistically significant. White

participants reported higher levels of perceived risk, and greater perceived negative impact on sleep and work predicted higher perceived risk.

3. Discussion

Demographic risk factors for COVID-19 may not be predictive of perceived COVID-19 risk. In this sample, age, gender, cases per capita, household size, and knowing someone diagnosed with COVID-19 – factors associated with actual risk [1,4,19–21] – did not predict perceived risk. It is particularly noteworthy that age was not associated with perceived risk, given that older individuals who are more likely to have comorbid conditions that exacerbate the likelihood of COVID acquisition are at greatest risk for severe COVID-19 illness [22]. It is possible that this null effect and the other null effects reflect an optimism bias [23] – a well-established phenomenon where individuals tend to underestimate the likelihood of experiencing adverse life events. Indeed, research [24] has found that individuals tend to estimate the probability of getting infected and/or infecting others with COVID-19 as lower for themselves than for someone similar to them. Race/ethnicity was predictive of perceived risk, but in the *opposite* direction of existing evidence: [4] White participants reported greater perceived risk than those of any other race/ethnicity. These findings align with existing risk perception literature [2,3] and with non-COVID-19 research, which indicates either weak or mixed relationships between known risk factors and risk perception [25].

This study has some important limitations. First, it is cross-sectional and, in a rapidly-evolving pandemic, perceptions of risk and vulnerability likely shift as disease-related knowledge increases or habituation to preventive measures occurs. Research should assess whether these findings hold as perceptions of burden and vulnerability change. Relatedly, the cross-sectional nature of this study limits our understanding of the relationship between sleep and perceived risk; this relationship may be bidirectional [26] or vary by individual. Second, the scale that was adapted to assess perceived risk was originally developed to measure perceived risk of HIV; the adapted scale has not yet been validated for COVID-19. The results should therefore be interpreted with caution. Third, the model accounted for 16% of the variance in perceived risk. Although effects of this size are common in the social and behavioral sciences, fields with an inherently greater amount of unexplainable variation, this finding suggests that other unmeasured factors may be contributing to perceived risk (e.g., individual and community attitudes toward COVID-19, sources of COVID-19-related information). Additionally, the categories assessed by the race/ethnicity variable are bounded by commonly used definitions drawn from the US Census. These characterizations are oversimplifications, but they do allow for comparison with other studies that used the same categories. In addition, subjective socioeconomic status was measured using a single three-point question that has not yet been validated, so demographic data from that measure should be interpreted cautiously, particularly given findings that suggest that more people in the US *identify* as middle class than would be placed there by objective measurement of their income, net worth, or educational attainment [27,28]. Finally, the aphorism that absence of evidence is not evidence of absence applies here. Although the effect sizes suggest no large, general connection between demographic risk factors and perceived risk, it remains to be seen if that connection exists for some populations and not others.

4. Public health implications

Since COVID-19 preventive measures represent a significant burden borne largely by individuals who are not yet sick, reduced risk perception may be a barrier to the initiation and maintenance of these behaviors. We identified three factors that predicted perceived risk – self-reported impact of the pandemic on sleep and work and being White. Factors theorized to increase actual risk of infection were not significant, suggesting that the personal impact of the pandemic predicts perceived risk in a way that demographic risk factors do not. Given the relationship between risk perception and engagement in protective practices, understanding factors associated with risk perception has implications for minimizing COVID-19 spread.

Declaration of Competing Interest

The authors have no competing interests to report.

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