Predictors of misperceptions, risk perceptions, and personal risk perceptions about COVID-19 by country, education and income

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ABSTRACT

Government interventions, such as mandating the use of masks and social distancing, play crucial roles in controlling the spread of pandemic infection. Adherence depends on public perceptions about pandemic risk. The goal was to explore the roles of education, income, and country on misperceptions, risk perceptions and personal risk perceptions about COVID-19. Data were extracted from 3 preregistered surveys. Binary logistic regressions were conducted to investigate the roles country, education, and income had on outcome variables. Across the USA, Canada, and UK, individuals in the highest income quartile were significantly less likely to hold misperceptions (OR=0.61, 95% CI 0.45 to 0.83) and to perceive personal risk (OR=0.38, 95% CI 0.20 to 0.75) regarding COVID-19 compared with individuals in the lowest income quartile. When comparing these income quartiles in the USA, the difference in perceived risk was heightened (OR=0.21, 95% CI 0.07 to 0.57). Citizens of the UK were more likely to have risk perceptions compared with citizens of the USA (OR=1.50, 95% CI 1.20 to 1.88). Citizens of Canada were less likely to perceive personal risk compared with US citizens (OR=0.40, 95% CI 0.23 to 0.69). Proper risk perception and understanding of COVID-19 are necessary for adherence to public health initiatives. The lowest income quartile was shown to have more misperceptions and personal risk perceptions across all 3 countries, highlighting the disproportionate impact of COVID-19 in this group. Our findings support the importance of education and income in affecting health perceptions and outcomes. Further research is needed to explore interventions to minimize misperceptions, accurately shape risk perception, and effectively communicate science.

Significance of this study

What is already known about this subject?

- It is important for the public to adhere to government recommendations in order to properly control the spread of COVID-19.
- The main considerations the public takes before accepting a protective action recommendation from the government include susceptibility to the disease, severity of the epidemic, effectiveness of protective actions and the cost of taking protective actions.
- As a result, the public's misperceptions, overall risk perceptions, and personal risk perceptions play a substantial role in public health initiative adherence and overall spread of disease.

What are the new findings?

- Individuals of lower socioeconomic or educational status are more likely to have misperceptions regarding COVID-19, indicating difficulty differentiating between falsehoods and reality regarding the disease.
- Risk perception about COVID-19 differed between countries, and the personal risk perception citizens felt was influenced by both country and income.
- Lower income was associated with greater personal risk perception across all 3 countries (USA, UK, and Canada).

How might these results change the focus of research or clinical practice?

- The present work indicates the statistically significant findings that education and income play a role in predicting misperceptions; country of origin predicts risk perception; and country of origin and income predict personal risk perception. Our findings support the importance of education and income in affecting health perceptions and outcomes. Further research is needed to explore interventions to minimize misperceptions, accurately shape risk perception, and effectively communicate science.

INTRODUCTION

In December 2019, cases of pneumonia of unknown cause emerged in Wuhan city, Hubei province of China. The WHO began to investigate these cases on January 1, 2020.[1] By January 9, it was determined that hospitalized patients were infected with SARS-CoV-2.[2 3] Over the next month, the first reported death due to SARS-CoV-2 infection was reported in China (January 11) and cases began to appear in Thailand (January 13), Japan (January 16), USA (January 21), France (January 24), Canada (January 26), and the UK (January 31).[1 4–6] By

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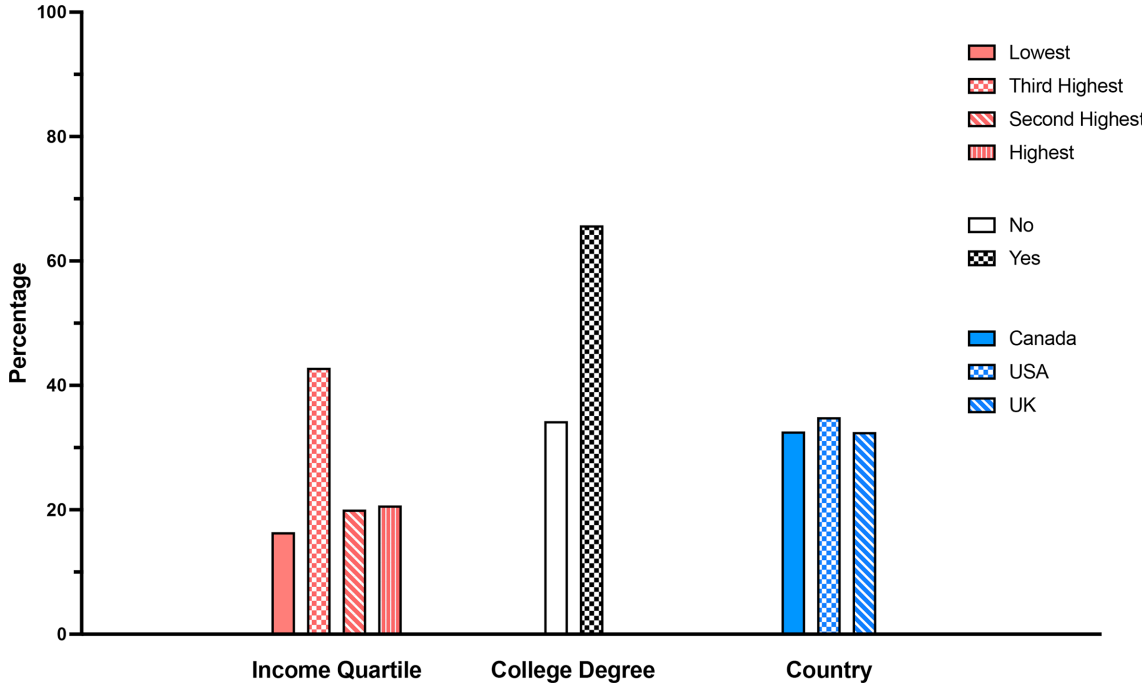

Figure 1 Demographics.

February 11, the WHO announced the disease resulting from infection with SARS-CoV-2 would be called COVID-19.[1–3] On March 11, COVID-19 was declared a pandemic by WHO and by April 4 there were over 1 million cases of COVID-19 worldwide.[1]

To take a closer look at the impact of COVID-19, one can look to the USA, Canada, and the UK, where this became clear in the months of March and April. In the USA, California had issued state-wide stay at home orders, the University of Minnesota began to test hydroxychloroquine as therapy for COVID-19, and the Coronavirus Aid, Relief, and Economic Security Act was signed into law by the US government.[4] The US–Canada border closed in late March (March 21) and in early April (April 13) nearly 5.4 million Canadians were receiving emergency aid from the federal government.[5] The end of March (March 23) also brought a UK-wide lockdown, although a £600 million (US$773 million) infection control package was not seen until early May (May 13).[7]

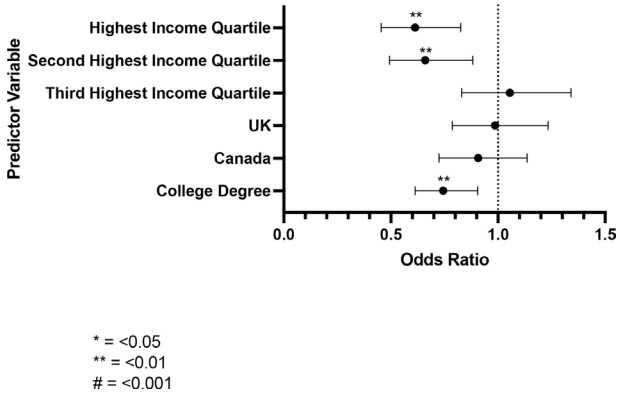

Figure 2 Predictors of misperception regarding COVID-19 by country, education, and income.

In addition to the response from governments to the COVID-19 pandemic, there has been widespread response from citizens, and misinformation being spread on social media platforms. Several conspiracy theories surrounding COVID-19 have contributed to misperceptions about the virus. Such conspiracies include the following: COVID-19 was engineered in a Wuhan lab, COVID-19 is no worse than the influenza, masks are unnecessary, and that wealthy elites are behind the virus to make more money.[8] This leaves the world in a state where officials and scientists must work to fight COVID-19, and to remedy the misperceptions that people hold.

Studies have used mathematical models to show that government interventions play a crucial role in controlling the spread of disease. Other studies have shown that when there is a lack of knowledge and treatment for a virus, behavioral measures are required to control the disease.[9] To prevent the further spread of COVID-19, government agencies have to launch successful public health initiatives and implement aggressive interventions, such as social distancing, restricted movements and mandatory mask use. However, it is crucial for the public to participate and adhere to the government's control measures. This includes bolstering their own knowledge of the virus and taking initiatives to change their health behaviors.

It is important for the public to adhere to government recommendations in order to properly control the spread of COVID-19. The health belief model (HBM) is a behavioral change theory constructed in order to highlight which beliefs should be communicated to a population in order to cause positive health behaviors.[10] The HBM highlights the factors involved in the public's willingness to adjust their health behavior during an epidemic outbreak. Though the

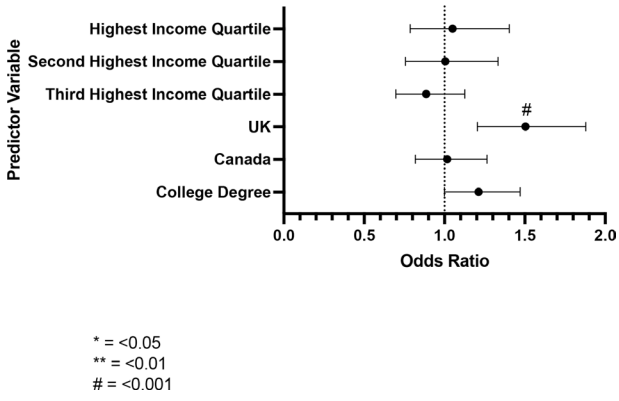

Figure 3 Predictors of risk perception regarding COVID-19 by country, education, and income.

correlation between HBM variables and health behavior varies in strength, they can be useful in providing a basic framework of factors that assess health behavior changes. [11] The main considerations the public takes before accepting a protective action recommendation from the government include susceptibility to the disease, severity of the epidemic, effectiveness of protective actions and the cost of taking protective actions.[9] As a result, the public's misperceptions, overall risk perceptions, and personal risk perceptions play a substantial role in public health initiative adherence and overall spread of disease.

Because attitudes about COVID-19 (ie, misperception and risk perception) have tremendous influence over the success of public health measures to curb COVID-19 transmission, it is essential to understand the factors that affect attitudes about COVID-19. Previous work has explored the role of political ideology and cognitive sophistication in explaining attitudes and misperceptions about COVID-19 across countries, such as the USA, UK and Canada.[12] However, there is a gap in our understanding of how education and income influence COVID-19 attitudes and misperceptions. Research supports the stark disparities in COVID-19 health outcomes across education and income level and understanding the role of such factors in determining COVID-19 attitudes and misperceptions is essential to both improve the success of public health measures and minimize these disparities.[13] This study investigates the roles of education and income in predicting misperceptions, risk perceptions, and personal risk perceptions about COVID-19 among residents of the USA, Canada, and the UK.

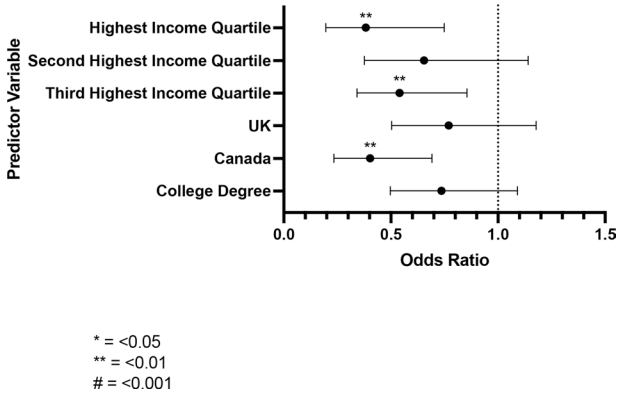

Figure 4 Predictors of personal risk perception regarding COVID-19 by country, education, and income.

MATERIALS AND METHODS

This study used open-source data supplied by Pennycook *et al*.[12] Data were extracted from preregistered survey conducted in all 3 countries by the polling firm *Prolific*. Parallel quota sampling was conducted for residents of the USA (n=689) and the UK (n=642). Convenience sampling was conducted for residents from Canada (n=644). Three key outcomes were analyzed in this study: (1) misperceptions about COVID-19, (2) risk perceptions about COVID-19, and (3) personal risk perceptions about COVID-19. Binary logistic regressions were conducted in order to investigate the roles country of residence, education and household income had on the survey outcomes.

Survey categories

Misperceptions about COVID-19 were measured through the creation of a large list of falsehoods (k=21) that were measured on a 7-point Likert scale ranging from strongly disagree to strongly agree. Examples include 'the seasonal flu is just as dangerous as the coronavirus'. The overall average score was calculated and then dichotomized. If a participant scored a 2 or below, this signified that the participant overall disagreed with the misperceptions presented. A score above 2 implied that the participant had internalized some misperceptions.

Risk perceptions were assessed using 8 direct questions such as 'the coronavirus poses a major threat to the public'. Responses were measured on a 7-point Likert scale ranging from strongly disagree to strongly agree. The overall average score was calculated and then dichotomized. A score of 6 or above implied the participant perceived risk from COVID-19, while a score below 6 signified the participant did not perceive risk from COVID-19.

Personal risk perceptions were assessed using 3 direct questions such as 'because of my age and/or pre-existing conditions, I am likely to have serious symptoms if I were to contract the coronavirus'. Responses were measured on a 7-point Likert scale ranging from strongly disagree to strongly agree. The overall average score was calculated and then dichotomized. A score of 6 or above implied the participant perceived personal risk from COVID-19 while a score below 6 signified the participant did not perceive personal risk from COVID-19.

Demographic variables

The independent variables used in this study were country of residence, education and household income as seen in figure 1. The countries studied included the USA, the UK and Canada. Education was dichotomized into participants with and without a college degree. Household income was divided into quartiles where the lowest quartile included households who made less than $29,999, the third highest quartile included participants who had a household income of $30,000–$59,999, the second highest quartile included participants who had a household income of $60,000–$89,000, and the highest

quartile included participants who had a household income greater than $90,000.

Statistical analysis

Statistical analysis was conducted using SPSS V.27.0 software.[14] Three separate binary logistic regression models were performed to predict: misperception (yes/no), risk perception (yes/no) and personal risk perception (yes/no). The following variables were entered into the models as predictors: country (dummy coded with USA as the reference), education status (college degree vs no college degree), and income (dummy coded with lowest quartile as reference). Models were considered significant if their Omnibus Tests of Model Coefficients were less than 0.05. If the model was significant, specific independent variables within the model were considered significant if their p values were less than 0.05.

RESULTS

Misperception of falsehoods

Our model was able to significantly predict individual levels of misperception regarding falsehoods regarding COVID-19 when looking across all 3 countries. Individuals in the lowest quartile of income held more misperceptions about COVID-19 than did individuals in the second highest or highest quartiles of income (OR=0.66 (0.49, 0.88), p=0.005 and OR=0.61 (0.45, 0.83), p=0.001, respectively). Furthermore, individuals without a college degree held more misperceptions than those with a college degree (OR=0.74 (0.61, 0.92), p=0.003). When looking within each country, our model proved significant within each country. However, within Canada and the USA, no individual predictors were significant. Within the UK, individuals within the lowest quartile of income held more misperceptions than individuals in the second highest or highest quartiles of income (OR=0.51 (0.26, 0.99), p=0.047 and OR=0.21 (0.07, 0.57), p=0.002, respectively). Lastly, those without a college degree in the UK held more misperceptions about COVID-19 than did those with a college degree (OR=1.56 (CI)) (figure 2).

Risk perception

An individual's country of residence was the only significant predictor of COVID-19 risk perception when looking across all 3 countries (USA, Canada, and UK). Specifically, residents of the UK were more likely to have COVID-19 risk perceptions compared with residents of the USA (OR=1.50 (1.20–1.88), p<0.001). Within each country, this logistic regression model was an insignificant predictor of COVID-19 risk perception (figure 3).

Personal risk perception

Related to COVID-19 risk perception is an individual's level of perceived personal risk. Personal risk perception offers a more nuanced view of a citizen's individualized risk of contracting the disease as opposed to the more generalized risk the country faces. Our model proved significant across all 3 countries, with participants in the lowest quartile of income perceiving more personal risks than those in the third highest or highest quartiles of income (OR=0.54 (0.34, 0.86), p=0.009 and OR=0.38 (0.20, 0.75), p=0.005, respectively). Residents of the USA perceived more personal risks than residents of Canada (OR=0.40 (0.23, 0.69), p=0.001). When analyzed within each country, our model only proved significant within the USA, where individuals in the lowest quartile of income perceived a greater level of personal risk than individuals in the third highest and highest quartiles of income (OR=0.51 (0.26, 0.99), p=0.047 and OR=0.21 (0.07, 0.57), p=0.002, respectively). ORs of all predictor variables from all statistically significant logistic regressions are included in the online supplemental material (figure 4)

DISCUSSION

This analysis reveals that individuals of lower socioeconomic or educational status are more likely to have misperceptions regarding COVID-19, indicating difficulty differentiating between falsehoods and reality regarding the disease. It seems intuitive that those with less education would have less experience in the realm of medicine and science, thus predisposing them to more readily believe falsehoods regarding COVID-19. Social media has become a widely available source of both information and misinformation, such as on Twitter where rumors of COVID-19 spreading through 5G networks run rampant.[15 16] In the absence of a strong science background and college-level courses, such rumors can gain traction and spread quickly. This puts the impetus on the scientific community to make statements regarding COVID-19 more readily accessible in terms of which platforms are used, and the language and presentation style.

The results of our study also demonstrated that risk perception about COVID-19 differed between countries, and the personal risk perception citizens felt was influenced by both country and income. Citizens in the UK were 1.5× as likely to perceive risk from COVID-19 compared with their US counterparts. As of January 2021, the USA has had 6842 cases of COVID-19 per 100,000 people, while the UK has had 4621 cases per 100,000 people.[17] According to the HBM, the discrepancy of cases between these 2 countries may, at least in part, be a result of a decreased perceived risk of COVID-19 by American citizens.

Our results also established that lower income was associated with greater personal risk perception across all 3 countries. Compared with the lowest income quartile, the members of the highest income quartile were only 0.383× as likely to perceive a personal risk from COVID-19. This emphasizes the global impact of socioeconomic disparities on COVID-19. Studies have shown that lower income communities have been less able to socially distance. From the outset of the COVID-19 pandemic, wealthier areas decreased mobility significantly more than poorer areas. Wealthy areas went from the most mobile before the pandemic to the least mobile, while the poorest areas went from the least mobile to the most mobile. Additionally, research has shown lower income communities suffer more from pre-existing health conditions and reduced access to healthcare. These findings suggest a double burden of the COVID-19 pandemic on people in the lower income bracket.[18]

The correlation between personal risk and income is intensified within the USA. Compared with the lowest

income bracket, the highest income bracket was only 0.205× as likely to perceive personal risk from COVID-19. This is consistent with the stark social inequities seen in US incomes. A study has shown that the death rate of COVID-19 per 100,000 person-years is 143.2 vs 83.3 in high-poverty versus low-poverty counties within the USA.[19]

Compared with the American citizens, Canadian citizens were only 0.403× as likely to perceive personal risk from COVID-19. Exploratory analysis has shown low levels of national preparedness, scale of testing and population characteristics were associated with increased national case load and overall mortality.[20] This is consistent with the 6842 cases per 100,000 people of COVID-19 in the USA versus the 1793 cases of COVID-19 per 100,000 people of COVID-19 in Canada.[17] Though there is not a significant difference between general risk perception of COVID-19 between the USA and Canada, Canadian citizens perceive less personal risk for the disease.

The increased personal risk perception seen in the USA, especially those in the lower income bracket, can potentially be due to the cost of healthcare. More than 78 million people in America do not have access to adequate health insurance.[21] Health insurance in the USA is typically provided by employers, so as unemployment continues to rise, millions are at risk of losing their healthcare coverage. Moreover, US healthcare costs are relatively more expensive. For instance, more than 12 days in the intensive care unit on assisted ventilation in the USA could exceed US$80,000. Additionally, those who are underinsured are forced to pay debilitating out-of-pocket expenses which could be up to thousands of dollars in deductibles and copays.

Limitations

There are limitations to this study. First, the income quartiles used in the regression analysis did not take into account family size nor currency in the 3 countries. Additionally, demographic variables were dichotomized in order to answer our research question of whether risk perceptions and misperceptions were present between comparison groups. As a result, there was some loss of data. Possible confounding variables not included in the model could also present as a loss of data. Lastly, this study focuses on perceptions about COVID-19, and the findings may not be generalizable to perceptions about other health information.

CONCLUSION

We report on the first study to explore the roles of education and income in predicting misperceptions, risk perceptions, and personal risk perceptions about COVID-19 among residents in the USA, Canada, and UK. The present work indicates the statistically significant findings that education and income play a role in predicting misperceptions; country of origin predicts risk perception; and country of origin and income predict personal risk perception. Our findings support the importance of education and income in affecting health perceptions and outcomes. Further research is needed to explore interventions to minimize misperceptions, accurately shape risk perception, and effectively communicate science.

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Predictor Variable	OR (95% CI)	P-value
Misperception about COVID-19		
Education (no college vs. college)	0.744 (0.613, 0.905)	0.003*
Country (Canada vs. USA)	0.907 (0.725, 1.136)	0.397
Country (UK vs. USA)	0.986 (0.787,1.234)	0.397
Income (1st vs. 2nd income quartile)	1.055 (0.830, 1.341)	0.660
Income (1st vs. 3rd income quartile)	0.660 (0.494, 0.882)	0.005*
Income (1st vs. 4th income quartile)	0.613 (0.454, 0.826)	0.001*
Risk Perception about COVID-19		
Education (no college vs. college)	1.212 (0.999, 1.470)	0.052
Country (Canada vs. USA)	1.017 (0.818, 1.264)	0.882
Country (UK vs. USA)	1.504 (1.204, 1.879)	<0.001*
Income (1st vs. 2nd income quartile)	0.886 (0.697, 1.126)	0.321
Income (1st vs. 3rd income quartile)	1.005 (0.757, 1.333)	0.975
Income (1st vs. 4th income quartile)	1.050 (0.786, 1.403)	0.743
Personal Risk Perception about COVID-19		
Education (no college vs. college)	0.736 (0.497, 1.091)	0.127
Country (Canada vs. USA)	0.403 (0234, 0.692)	0.001*
Country (UK vs. USA)	0.770 (0.503, 1.178)	0.228
Income (1st vs. 2nd income quartile)	0.540 (0.342, 0.855)	0.009*
Income (1st vs. 3rd income quartile)	0.655, 0.376, 1.141)	0.135
Income (1st vs. 4th income quartile)	0.383 (0.196, 0.749)	0.005*

Country	Predictor Variable	OR (95% CI)	P-value
Personal Risk Perception about COVID-19			
USA	Education (no college vs. college)	0.839 (0.461, 1.529)	0.567
	Income (1st vs. 2nd income quartile)	0.506 (0.258, 0.992)	0.047*
	Income (1st vs. 3rd income quartile)	0.445 (0.191, 1.035)	0.060
	Income (1st vs. 4th income quartile)	0.205 (0.074, 0.568)	0.002*

Country	Predictor Variable	OR (95% CI)	P-value
Misperception about COVID-19			
United Kingdom	Education (no college vs. college)	0.639 (0.461, 0.886)	0.007*
	Income (1st vs. 2nd income quartile)	0.870 (0.610, 1.239)	0.440
	Income (1st vs. 3rd income quartile)	0.586 (0.354, 0.968)	0.037*
	Income (1st vs. 4th income quartile)	0.414 (0.190, 0.900)	0.026*