



WAVE 4

National Income Dynamics
Study (NIDS) – Coronavirus
Rapid Mobile Survey (CRAM)

Flip side of risk perception: On the negative influence of risk perception on subjective health during the pandemic

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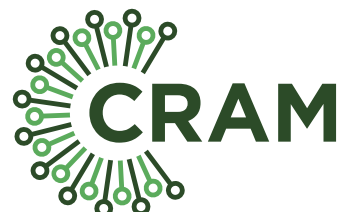
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NATIONAL INCOME DYNAMICS STUDY



CORONAVIRUS RAPID MOBILE SURVEY 2020

Flip side of risk perception: On the negative influence of risk perception on subjective health during the pandemic

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Abstract

Risk perception is an important variable in the context of the COVID-19 pandemic, this is because the risk communication literature and several theories related to it argues that this variable encourages the adoption of preventative measures. However, heightened risk perception can also have negative consequences for general wellbeing (for example in terms of psychological distress). In this paper, we consider the relationship between risk perception and two health measures (self-assessed health and depressive symptoms) in the context of the COVID-19 pandemic. Furthermore, adopting the Extended Parallel Process Model, we consider the relationship between risk perception and health when risk perception interacts with self-efficacy.

Our results show that across the waves of the NIDS-CRAM data, risk perception is correlated with poor health under both measures of health. In our analysis we are unable to ascertain whether this is as a result of reverse causality between risk perception and health. Furthermore, we found limited evidence that when risk perception is not balanced with self-efficacy the correlation between poor health and risk perception becomes stronger. These results underscore the importance of giving careful consideration to the crafting of risk communication.

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Executive summary

In the context of a public health crisis like COVID-19 perception of risk is important because it is correlated with the adoption of preventative measures. However, this study argues that risk perception is also negatively correlated with poor health. Specifically, this study considers the relationship between risk perception and two measures of health (self-assessed health and depressive symptoms, where the former is a more general concept compared with the latter). Furthermore, we consider the relationship between health and risk perception when it is interacted with self-efficacy.

To do this we consider the Extended Parallel Process Model (EPPM) (Witte, 1994, 1992) that makes prediction on the adoption of preventative measures based on the interaction between risk perception (feelings of personal vulnerability to a condition) and self-efficacy (the belief that one's response can yield desirable result). The interaction between the two variables yields three groups

1. Responsive (positive risk perception and positive self-efficacy)
2. Avoidance (positive risk perception and no self-efficacy)
3. Indifference/Proactive (no risk perception and either positive or negative self-efficacy)

EPPM predicts that those in the responsive category will adopt preventative measures because risk perception is balanced with self-efficacy. On the other hand, those in the avoidance category may reject the message and engage in maladaptive behaviour as a coping mechanism. We consider the relationship between these attitudinal groupings and self-reported health. The analysis is based on the National Income Dynamics Study-Coronavirus Rapid mobile Survey (NIDS-CRAM), a longitudinal survey of South Africans currently with four waves of data collected between May/June 2020 and Feb/March 2021.

Our main findings are as follows:

- Positive risk perception (without interaction with self-efficacy) is correlated with poor health both in terms of self-assessed health and depressive symptoms while the relationship between self-efficacy and health is not statistically significant (these results are consistent across the 4 waves of data considered)
- Considering the groupings resulting from interacting risk perception with self-efficacy we found that being in the low-risk groups (Indifference/Proactive) significantly reduces the probability of reporting poor self-assessed health and depressive symptoms.
- We also found limited evidence that when risk perception is not balanced with self-efficacy the relationship between risk-perception and poor health is stronger (note that this result only holds for self-assessed health and when the model controls for chronic conditions)

Other results show that:

- The composition of attitudinal groupings is related to socioeconomic status. Attitudinal groups with positive risk perception (responsive and avoidance) are concentrated among the rich while attitudinal groups with low-risk perception are concentrated amongst the poor.
- Reporting of poor health is sensitive to the health measure i.e. while the Non-Black population are more likely to report poor psychological health (measured by depressive symptoms), Black Africans are more likely to report poor general health (as measured by self-assessed health).
- Finally, our results suggest that while the income-health gradient in self-assessed health is steeper during this period (i.e. poor self-assessed health is still concentrated among the poor), the income-health gradient in depressive symptoms has become less steep (poor psychological health is more concentrated among affluent groups relative to the pre-pandemic period)

We note that the highlighted relationships are correlations as against causal relationships. It is possible that there is reverse causality between risk perception and health. However, the results

show the relationship between risk perception health and socio-economic status in the context of the pandemic.

Specifically, we note that a one size fits all kind of messaging that ignore the attitudinal group of sections of the society (by virtue of their risk perception and self-efficacy) may have adverse implication for health. High efficacy groups should receive targeted messages that reinforce their efficacy beliefs while underscoring the risk they face, while low efficacy groups should receive messages that enhance prevention efficacy while addressing their risk perception (O'Hair and O'Hair, 2021)

Introduction

Unexpected public crisis event like the COVID-19 pandemic can have negative consequences for the wellbeing of the public. This could take the form of psychological distress like stress disorder and depression (Li & Lyu, 2021; Zhao et al., 2009) or increased prevalence of poor health/increased inequality in wellbeing (Nwosu & Oyenubi, 2021). In the context of a pandemic perceiving and avoiding risks are natural instincts of living beings (Li & Lyu, 2021). Risk perception (i.e. feelings of personal vulnerability to a condition (Janz & Becker, 1984)) is correlated with psychological and behavioural response in the context of a public event crisis (Li & Lyu, 2021). Research has shown that positive risk perception is correlated with the adoption of preventative measures (Cowling et al., 2011; Girma et al., 2020; Sobkow et al., 2020) in general and evidence from South Africa suggests that this relationship is consistent with South African data during the COVID-19 pandemic (Kollamparambil & Oyenubi, 2021; Maughan-Brown et al., 2021). On the other hand, the literature also recognises that heightened risk perception can have negative consequences for wellbeing in terms of psychological distress (Sharifi-Heris et al., 2021; Yeli Wang et al., 2020; Yi Wang et al., 2020). This relationship too has been shown to be consistent with the South African experience during the pandemic (Kim et al., 2020; Oyenubi & Kollamparambil, 2020).

The implication is that positive risk perception in the context of the COVID-19 pandemic may be desirable because it fosters the adoption of preventative measures. However, it may also have negative consequences for wellbeing in terms of the psychological response to the threat. Specifically, the relationship between risk perception, preventative behaviour and wellbeing suggests that there is a trade-off between the benefits of risk perception (in terms of adoption of preventative measures) and its cost (in terms of psychological distress/ negative impact on health). Central to these relationships is risk communication, this is because both psychological and behavioural response depends on how communication about the risk is received. Effective risk communication induces realistic risk perceptions, correct knowledge and skills to promote and enable precautionary practices (Brug et al., 2009). However, risk perceptions are often biased (Weinstein, 1988), this is because the reaction elicited by risk communication may be heterogeneous based on individual characteristics and experiences. Unrealistic optimism may lead to reduced adoption of preventative measures because of a false feeling of security. On the other hand, pessimistic bias (which is more likely for new and unfamiliar risks) may lead to unnecessary mass panic that may harm wellbeing (Brug et al., 2009). This is important in the context of the COVID-19 pandemic in South Africa (a country with high socio-economic inequality).

Socio-economic disparity may influence the reaction elicited by risk communication about the pandemic, resulting in differences in risk perception across socio-economic groups. Specifically, before the pandemic, there is socio-economic inequality in health and wellbeing in South Africa (Kollamparambil, 2020; Omotoso & Koch, 2018), which may have been exacerbated by the pandemic (Nwosu & Oyenubi, 2021). One may therefore expect positive risk perception to be concentrated amongst the poor since poor health is concentrated amongst the poor before the pandemic. This is because in the context of the COVID-19 pandemic, pre-existing conditions (in form of chronic illnesses for example) predicts fatality (Atkins et al., 2020). However, existing evidence suggests that positive risk perception of COVID-19 is concentrated amongst the non-poor (Burger et al., 2020; Kollamparambil & Oyenubi, 2020), with optimism bias more pronounced among the less affluent

groups. This can be taken as evidence of the heterogeneous effect of risk communication. Another important point is that existing analyses do not consider the interaction between risk perception and self-efficacy. The relationship between risk perception and health may be mediated by self-efficacy. Our main question is, what is the relationship between risk perception and wellbeing in the context of the pandemic in South Africa when the interaction between risk perception and self-efficacy is taken into consideration.

This question is important because perception of risk is a necessary but often not sufficient condition for the adoption of preventative measures. Specifically, higher risk perception may only predict protective behaviour when individuals believe that effective protective actions are available (response efficacy) and when they are confident that they can engage in such protective action (self-efficacy). Indeed, Kollamparambil et al (2021) have shown that an imbalance between risk perception and self-efficacy reduces the probability of adopting some preventative measures amongst South Africans. In this paper, we posit that apart from its implication for the adoption of protective measures, the interaction between risk perception and self-efficacy has implication for health outcomes. Specifically, under the Extended Parallel Process Model (EPPM) (Witte, 1992, 1994) adopted as an analytical framework in this study, individuals can be categorized into three attitudinal groups based on risk perception and self-efficacy. The first two groups are characterized by positive risk perception (i.e. Responsive attitude – high-risk perception and self-efficacy and Avoidance attitude – high-risk perception and low self-efficacy). The last group is characterized by low-risk perception, however, this can be thought of as two groups (i.e. Proactive– low-risk perception and high self-efficacy and Indifference – low-risk perception and self-efficacy), as done for example by (Rimal, 2001), see *Table 1* below.

Table 1: Attitudinal groups under the Extended parallel Process Model

	Self-efficacy (Yes)	Self-efficacy (No)
Risk perception (Yes)	Responsive	Avoidance
Risk perception (No)	Proactive	Indifference

However, Witte’s construct argues that the proactive and indifference categories are in the same group because in these groups risk perception is low. Specifically, Proposition 1 in (Witte, 1992) state that “When perceived threat is low, regardless of perceived efficacy level, there will be no further processing of the message⁴. The implication is that the proactive and indifference categories are similar because individuals in these groups will not process the risk communication further because of low-risk perception. In this study, we examine the implication of these attitudinal groupings for health outcomes under the COVID-19 pandemic.

Using the National Income Dynamic Study-Coronavirus Rapid Mobile (NIDS-CRAM) survey this paper examines the relationship between the three attitudinal groups (Responsive, Avoidance and Proactive/Indifference) and health outcomes as measured by self-reported health and depression scores⁵. First, we found that risk perception is correlated with poor health irrespective of how health is measured. Second, it is shown that considering risk perception alone (i.e. ignoring its interaction with self-efficacy) ignores important insight about the relationship between risk perception and health outcomes (similar to the differential effect of risk perception on the adoption of preventative measures based on the mediating effect of self-efficacy). Specifically for self-assessed health, while risk perception is correlated with self-reported poor health, being in the avoidance category (i.e. positive risk perception with no self-efficacy) appear to increase this correlation compared to being in the responsive category (i.e. positive risk perception with positive self-efficacy)⁶. This suggests that a balance between risk perception and self-efficacy matters for health. Third, we found that the kind of poor health reported varies by race. Black Africans are significantly more likely to report poor

4 Note that (Rimal, 2001) use the 4 categories (Responsive, Proactive, Avoidance and Indifference). We elect to use Witte’s original categorization in our analysis but refer to Rimal’s categorization where appropriate.
 5 Note that another report with the same authors consider the relationship between the attitudinal groups and adoption of preventative measures
 6 Note that this result holds only when limit the sample to those who did not report chronic illness

self-assessed health, but they are less likely to report depressive symptoms. While reporting of poor health in non-black groups is more likely to be in terms of depressive symptoms. Therefore poor health for Black Africans tends to be in terms of self-assessed health while for non-black groups it is in terms of depressive symptoms. The implication of this is that the relationship between the attitudinal groups and health may depend on the measure of health under consideration. Fourth, we found that socioeconomic status is correlated with attitudinal groupings. The affluent are more likely to be in the responsive or avoidance categories (groups with positive risk perception) while the less affluent are more likely to be in the low-risk perception categories (proactive or indifference). This is consistent with the finding that positive risk perception of COVID-19 is concentrated amongst the affluent. It, therefore, does appear that while the income-health gradient in self-assessed health is steeper during this period, the income-health gradient in depressive symptoms has become less steep.

Overall the results show that positive risk perception and the attitudinal group that an individual belongs to has implication not only for their behavioural response (in terms of adoption of preventative measures) but is also correlated with their health outcomes. This underscores the importance of leveraging on these perceptions in tailoring targeted risk communication about the pandemic.

Justification of the study and brief review of relevant literature

This paper adopts the Extended Parallel Process Model (EPPM) (Witte, 1992, 1994) as its analytical framework. This model emerged under the broader fear appeal literature (Tannenbaum et al., 2015). Other models that relate to the fear appeal literature include Parallel Process Model (PPM) (Leventhal, 1970, 1971), Health Belief Model (HBM) (Becker, 1974; Becker et al., 1977), Protective Motivation Theory (PMT) (Maddux & Rogers, 1983; Rogers, 1975) etc. Fear appeals are messages that try to persuade people about the potential harm that may happen to them if they do not accept the messages' recommendations (Tannenbaum et al., 2015; Witte, 1992). According to Weinstein (1988), the principal variables in these theories are *perceived susceptibility* (the likelihood of being harmed if no action is taken), *perceived severity* of the threat (the amount of harm that would be experienced if no action is taken), *perceived effectiveness* of the precaution (in terms of reduction in susceptibility or severity), and *perceived cost* of adopting precaution (time, energy and money). The effectiveness of fear appeal lies in whether the recipients of the message accept or reject it. According to the HBM, PPM and EPPM fear appeals work only when accompanied by efficacy messages (Tannenbaum et al., 2015; Witte & Allen, 2000).

Of particular interest is the prediction of the EPPM on the mediating role of self-efficacy in the relationship between risk perception and preventative behaviour (we extend this model to health outcomes). The key insight of Witte (1992) is to differentiate between danger and fear control strategies. Specifically, EPPM posits that the interaction between perceived risk and self-efficacy is such that, when perceived risk is high enough to induce fear, individuals adopt either *fear control* (defined as an emotional process where people respond to and cope with fear, not the danger) strategies or *danger control* (cognitive processes where individuals evaluate their susceptibility and their ability to perform the recommended response) strategies.

According to the EPPM, when an individual is presented with a fear appeal depicting the components of threat (such as contracting COVID-19), this appeal will initiate two appraisals. The first appraisal has to do with the perceived threat (risk perception), if this results in moderate to high perceived risk, fear is elicited (Easterling & Leventhal, 1989). The second appraisal, has to do with the evaluation of the efficacy of the recommended response (i.e. can preventative measures mitigate the risk?). When risk perception is low, there is no motivation to process the message further, therefore efficacy is not evaluated and there is no response to the fear appeal (Witte, 1992). When both risk perception and perception of efficacy are high, *danger control* process is initiated. This results in the adoption of strategies to avert the threat (e.g. adoption of preventative measure to reduce the risk of contracting COVID). In this case, the individual responds to the danger and not fear. Conversely, when risk perception is high but perceived efficacy is low, the fear control process

is initiated. This may manifest as maladaptive responses (e.g. denial). For example, individuals with positive risk perception but low self-efficacy may engage in maladaptive behaviour to reduce fear and anxiety (Witte, 1992). In this case, the individual responds to the fear and not the danger. In summary, risk perception determines the degree or intensity of the reaction to the message while perceived efficacy determines the nature of the reaction (i.e. which process is initiated – danger or fear control).

These constructs are important in the context of high socioeconomic inequality in South Africa. The preventative measures recommended to curb the transmission of COVID-19 can be argued to attract different relative costs based on socio-economic status. For example, regular hand washing or sanitizing may be more difficult for the poor to observe both because of the cost of sanitisers and/or the fact that service delivery (specifically water supply) in poor areas of South Africa is less reliable when compared to affluent areas. Messaging that an important way to prevent contracting COVID-19 is regular hand washing in areas where access to water is tenuous may reduce the self-efficacy of residence of those areas. Social distancing is another example, COVID-19 preventative message advocate for social distancing, however, socio-spatial inequality implies that poor areas (like townships and informal shacks) tend to be crowded and social distancing may not be a practical aspiration in such areas (especially under lockdown conditions). Lastly, South Africa declared a State of National Disaster on March 15, 2020, and went into a total lockdown on March 26 – designated Level 5 restrictions – with only essential travel and services allowed to curb the spread of the virus. This resulted in a significant drop in economic activities. This forced labour market disengagement has significant economic cost for workers, especially vulnerable workers. For example, women, manual workers, informal workers and those at the bottom half of the income distribution have suffered disproportionately higher rates of job loss (Jain et al., 2020).

This raises the relative cost of the pandemic for the poor considerably. Therefore the cost component of the models discussed above comes into play. For example, if we assume that positive risk perception is uniformly distributed across the strata of socio-economic status, then cost as a mitigating factor for self-efficacy will imply that the poor with positive risk perception will be in the avoidance category while the non-poor will be responsive. Our main argument is that this does not only affect the adoption of preventative measures but also health outcomes⁷. The same fear appeal may therefore produce different combinations of perceptions of self-efficacy and risk in different people (Witte, 1992) based on their social-economic status and this has implications for health outcomes.

We note that it is plausible that there are two-way relationships between risk perception (on the one hand) and health and behavioural response (on the other hand). For example, individuals with poor self-rated health before the pandemic may report greater risk perception because their health concern may lead them to believe they are more susceptible to infection and complication (Jacobs et al., 2010). Furthermore, the adoption of preventative measures may have a feedback effect on risk perception. It is therefore important to note that our analysis focuses on the correlation between these variables and not causal relationships.

The implication of the Extended Parallel Process Model for health outcomes in the context of COVID-19 pandemic in South Africa.

As noted earlier the interaction between risk perception and self-efficacy defines four attitudinal groups in terms of the adoption of preventative measures. However, in this section, we explore the implication of being in these groups for health outcomes. Here we follow the categorization of Rimal (2001) i.e. 4 categories.

⁷ It is important to note that the outcome of fear appeals can be defined in terms of the content of the message or the reaction they produce in the audience (O'keefe, 2015). Our analysis does not address the question of whether the messaging around COVID-19 elicit fear in the population since we do not have data to address this question effectively. We instead take the reaction of individuals as the result of a separate process and focus on how this reaction is correlated with health outcomes (and to a lower extent, adoption of preventative measure)

1. Responsive attitude: Individuals with high-risk perception (of contracting COVID) and high perception of self-efficacy (preventative measure is effective in mitigating the threat). Given that these individuals are aware of the risk and believe they can implement the message's recommendation to avert the threat, EPPM predicts that they will accept the message (i.e. adopt a danger control strategy). For example in the context of COVID-19, they are expected to adopt preventative measures. In terms of health, positive risk perception predicts negative health but since risk perception is counterbalanced by self-efficacy for responsive individuals, the relationship between risk perception and health may be more muted compared to the situation where self-efficacy is also low.
2. Avoidance attitude: Individuals with high-risk perception but low self-efficacy. These individuals are aware of their risk status but have low perceived ability to mitigate the threat. To control the overwhelming fear stemming from high-risk perception/ low perceived efficacy, this group may either consciously or unconsciously deny the threat or react against the message. For example, they can engage in maladaptive behaviour to reduce fear and anxiety (Witte, 1992). For example, COVID preventative measures encourage social distancing, regular hand washing and the use of sanitisers. These are relatively expensive strategies for communities with low social-economic status living in crowded areas with unreliable service delivery. All these factors lower self-efficacy and the EPPM predicts that such groups may deny the message as a fear control strategy. It is not clear what this implies for health outcomes, if the denial is effective in reducing fear of the threat then this may result in lower psychological distress. However, if the denial does not reduce perceived risk, psychological distress may worsen compared to other attitudinal groups.

Note the last two categories can be thought of as one category (Witte, 1992)

3. Proactive attitude: Low-risk perception with high self-efficacy. EPPM predicts that when risk perception is low regardless of perceived efficacy there may be no further processing of the message. However, Witte (1992) noted that every fear appeal induces some inherent level of risk which may influence the outcome. Therefore, this group may exhibit danger control strategies (i.e. accept the message and adopt preventative behaviour) (Rimal, 2001). Rimal (2001) noted that the adoption of preventative measures by proactive individuals is driven by their desire to remain free of the threat rather than fear associated with risk perception. Since risk perception is low in this group, it suggests that health outcomes may be better when compared to the responsive and avoidance groups.
4. Indifference attitude: Individuals with low-risk perception and low self-efficacy. This group may not adopt preventative measures because of low risk and efficacy. In terms of health, the absence of perceived risk and self-efficacy suggests that their health outcomes may not be impacted.

We note that in our analysis we will focus on three categories i.e. Responsive, Avoidance and the last two categories (Proactive & Indifference) as one group. This is to keep the analysis consistent with the original attitudinal groups discussed by Witte (1992). However, we note that Rimal (2001) use the four groups as discussed above.

Data

Waves 1 to 4 of the National Income Dynamic Study-Coronavirus Rapid Mobile (NIDS-CRAM) survey is used to examine the relationship between the attitudinal groups and health outcomes as measured by self-reported health and depression scores. NIDS-CRAM is designed to track the socio-economic and health effects of the COVID-19 pandemic and the associated lockdown. Participants of the NIDS-CRAM survey were drawn from South Africa's national household survey, the National Income Dynamics Study (NIDS). NIDS-CRAM sample is selected from wave 5 (conducted in 2017) of the NIDS sample using 'batch sampling'. Sampling in batches offered flexibility in adjusting the sample rate as the surveying progressed, and as information about stratum response became available. The weighted NIDS-CRAM survey data, therefore, reflects the outcomes in 2020 for a broadly representative sample of those 15 years and older from NIDS Wave 5 in 2017 who were followed up 3 years later (Kerr et al., 2020).

We note that the waves of NIDS-CRAM were conducted under different lockdown restrictions⁸ which may affect the distribution of attitudinal groups in the population. Our outcome variables are self-reported depression score (for waves 2 & 3) and self-assessed health (for waves 1 & 4). Note that question about depression score was not included in wave 4 & 1 while self-assessed health is not included in waves 2 & 3. Depressive symptoms are measured by a 2-question version of the Patient Health Questionnaire (PHQ-2).⁹ The two questions administered to derive the PHQ-2 measure are: “Over the last 2 weeks, have you had little interest or pleasure in doing things?” and “Over the last 2 weeks, have you been feeling down, depressed or hopeless”. Both questions could be responded to as “not at all”, “several days”, “more than half the days” or “nearly every day”. The responses are coded from 0 to 3, creating the outcome variable of the PHQ-2 scale with a range of 0 to 6, with increasing values indicating higher levels of depressive symptoms. The study prefers to use the variable as a continuum of distress rather than impose cut-offs (Ardington & Case, 2010; Burger et al., 2017; Posel et al., 2020; Steffick, 2000; Tomita & Burns, 2013), which have been found to vary across different language groups in South Africa (Baron et al., 2017). Self-assessed health (SAH) is captured on a Likert scale comprising excellent, very good, good, fair and poor. We note that self-rated health is a more general concept when compared with self-rated depressive symptoms, this is because the former provides an assessment of subjective health that includes physical and psychological aspects of health (Ambresin et al., 2014; Mavaddat et al., 2011). It is therefore possible that the relationship between the attitudinal groups and health may vary by measures of health (although we note that since the surveys were conducted at different points in time and under different lockdown levels, and this may also influence the results).

Tables 2 & 3 show the summary statistics for waves 3 and 4 respectively (summary statistics for waves 1 & 2 are provided in the appendix. Note that household income per capital is missing in wave 3. The main independent variables are the attitudinal groups, these variables are derived from two dummy variable questions i.e. risk perception (*Do you think you are likely to get coronavirus?*) and self-efficacy (*Can you avoid getting coronavirus?*). From these two variables the respondents are assigned to the various attitudinal groups as discussed in the previous section (see Table 1). For example, a yes to the risk perception and self-efficacy question means the individual is in the responsive category. The other covariates included in the analysis are household hunger, household income per capita (wave 4 alone), number and type of grant received by the respondent and their household, an indication as to whether household income has changed over the last 4 weeks, area description (e.g. Informal settlement), demographic characteristics (i.e. age, gender and race), relationship status, dwelling type (e.g. Informal/shack), household size (only for wave 3) employment status, years of schooling and number of preventative measures adopted.

⁸ wave 4 (conducted between 2nd Feb 2021 – 10th March 2021) lockdown levels 3 & 1, wave 3 (conducted between 2nd Nov 2020 – 13th Dec 2020) lockdown level 1, wave 2 (conducted 13th July 2020 – 13th Aug 2020) lockdown level 3, wave 1 (7th May 2020 – 27th June 2020) lockdown levels 4 & 3, see <https://www.gov.za/covid-19/about/about-alert-system#>

⁹ PHQ-2 is the abbreviated version of the widely used PHQ-9 (Kroenke et al., 2003). It has been validated as a reliable screening method for depressive symptoms in South Africa (Baron et al., 2017)

Table 2: Wave 4 summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Health					
1. Excellent	4,728	0.122885	0.32834	0	1
2. Very good	4,728	0.232868	0.422704	0	1
3. Good	4,728	0.333756	0.471604	0	1
4. Fair	4,728	0.206853	0.405092	0	1
5. Poor	4,728	0.103638	0.304823	0	1
Attitudinal groups					
responsive	4,728	0.34264	0.474642	0	1
proactive	4,728	0.521151	0.499605	0	1
avoidance	4,728	0.052877	0.223811	0	1
Hunger	4,728	0.186125	0.389249	0	1
Household income per capita	4,728	1670.269	4715.558	0	150000
No of Child Support Grants	4,728	1.529611	1.652728	0	10
No of Old Age Pension	4,728	0.403342	0.649458	0	4
Receipt of any Govt grant	4,728	0.431684	0.495363	0	1
Household income change					
1. Increased	4,728	0.043782	0.204631	0	1
2. Decreased	4,728	0.212352	0.409016	0	1
3. Stayed the same	4,728	0.743866	0.436543	0	1
area2					
1. Traditional area/chiefdom	4,728	0.276438	0.447283	0	1
2. Informal settlement	4,728	0.035745	0.185672	0	1
3. Township	4,728	0.347927	0.476363	0	1
4. Formal residential	4,728	0.21764	0.412685	0	1
5. Farm	4,728	0.08841	0.28392	0	1
6. Small holding	4,728	0.033841	0.180839	0	1
age	4,728	41.1563	15.53159	18	98
age2	4,728	1935.021	1473.452	324	9604
male	4,728	0.361887	0.480597	0	1

race					
1. African	4,728	0.866963	0.339651	0	1
2. Coloured	4,728	0.081007	0.272874	0	1
3. Asian/Indian	4,728	0.008883	0.093841	0	1
4. White	4,728	0.043147	0.20321	0	1
With a partner	4,728	0.3272	0.469241	0	1
Dwelling					
1. House/flat	4,728	0.767555	0.422436	0	1
2. Trad/mud	4,728	0.109983	0.312902	0	1
3. Informal/shack	4,728	0.09687	0.295812	0	1
4. Other	4,728	0.025592	0.157932	0	1
Employment Status					
1. Not Economically active	4,728	0.22187	0.415548	0	1
2. Unemployed Discouraged	4,728	0.148266	0.355401	0	1
3. Unemployed Strict	4,728	0.163283	0.369662	0	1
4. Employed	4,728	0.466582	0.498935	0	1
Years of schooling	4,728	10.68866	4.077204	0	22
Years of schooling squared	4,728	1.308676	0.792299	0	4.84
No of preventative measures	4,728	2.740059	1.072527	0	8

Table 3: Wave 3 Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
PHQ_cat					
0	5,122	0.418391	0.493343	0	1
1	5,122	0.155799	0.3627	0	1
2	5,122	0.151894	0.358953	0	1
3	5,122	0.139594	0.346599	0	1
4	5,122	0.072433	0.259228	0	1
5	5,122	0.018938	0.136319	0	1
6	5,122	0.042952	0.202769	0	1

Attitudinal groups					
responsive	5,122	0.31433	0.464294	0	1
proactive	5,122	0.551542	0.497385	0	1
avoidance	5,122	0.046662	0.210933	0	1
Hunger	5,122	0.210269	0.40754	0	1
Household income per capita#					
No of Child Support Grants	5,122	1.53319	1.705801	0	15
No of Old Age Pensions	5,122	0.417025	0.675286	0	11
Receipt of any Govt grant	5,122	0.461929	0.498597	0	1
Household size	5,122	5.44182	3.290147	1	26
Household income change					
1. Increased	5,122	0.087271	0.282259	0	1
2. Decreased	5,122	0.413901	0.492579	0	1
3. Stayed the same	5,122	0.498829	0.500047	0	1
area2					
1. Traditional area/chiefdom	5,122	0.275674	0.446897	0	1
2. Informal settlement	5,122	0.035728	0.18563	0	1
3. Township	5,122	0.342249	0.474509	0	1
4. Formal residential	5,122	0.222569	0.416012	0	1
5. Farm	5,122	0.089809	0.285935	0	1
6. Small holding	5,122	0.033971	0.181173	0	1
age	5,122	40.90961	15.71371	18	100
age2	5,122	1920.468	1491.438	324	10000
male	5,122	0.369192	0.482633	0	1
race					
1. African	5,122	0.862944	0.34394	0	1
2. Coloured	5,122	0.081804	0.274093	0	1
3. Asian/Indian	5,122	0.0082	0.09019	0	1
4. White	5,122	0.047052	0.211771	0	1
With a partner	5,122	0.336392	0.472521	0	1
Dwelling type					
1. House/flat	5,122	0.770988	0.420238	0	1
2. Trad/mud	5,122	0.114994	0.319046	0	1
3. Informal/shack	5,122	0.093128	0.29064	0	1
4. Other	5,122	0.02089	0.143031	0	1

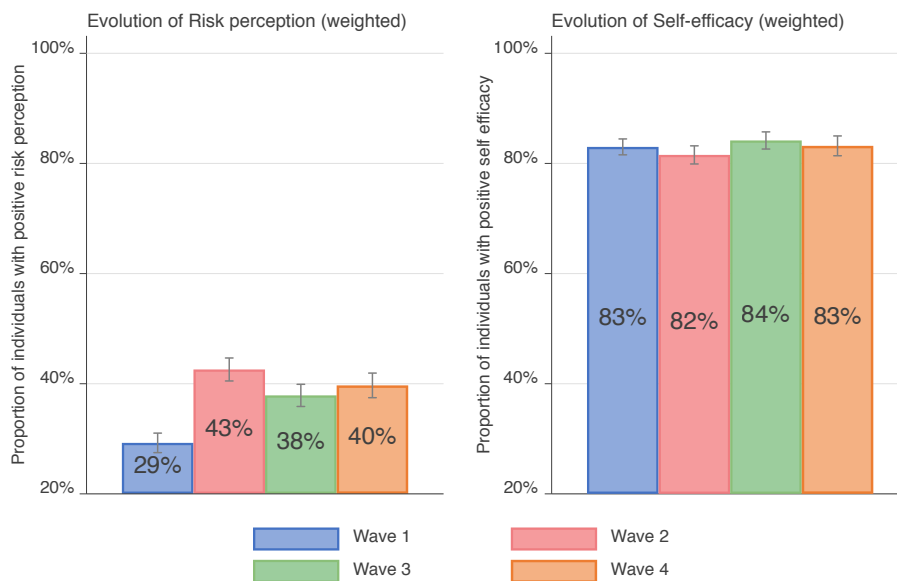
Employment status					
1. Not Economically active	5,122	0.203436	0.402594	0	1
2. Unemployed Discouraged	5,122	0.149941	0.357049	0	1
3. Unemployed Strict	5,122	0.164389	0.370664	0	1
4. Employed	5,122	0.482234	0.499733	0	1
Years of schooling	5,122	10.70812	4.119449	0	22
Years of schooling squared/100	5,122	1.316304	0.800918	0	4.84
No of preventative measures	5,122	2.612456	1.006882	0	8

#this question was not asked in wave 3

Preliminary analysis

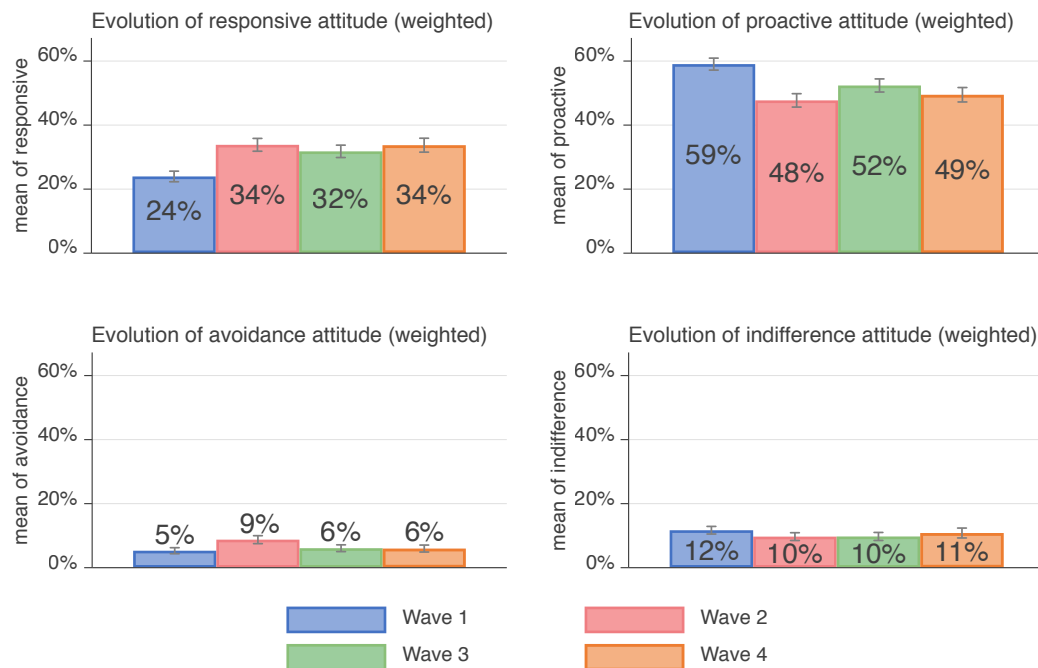
We start by exploring how the base variables (risk perception and self-efficacy) for the attitudinal groups and the outcomes (self-assessed health and depressive symptoms) have evolved. *Figure 1* shows the evolution of risk perception and self-efficacy over the 4 waves of NIDS CRAM.

Figure 1: Evolution of Risk perception and Self -efficacy



Source NIDS-CRAM waves 1 to 4
Author's calculations

Figure 2: Evolution of the 4 attitudinal groups



Source NIDS-CRAM waves 1 to 4
Author's calculations

Figure 1 shows that there was a 25% jump in the number of respondents that reported positive risk perception between wave 1 and 2, after which the figure stabilizes at about 40% of the population. On the other hand, self-efficacy is high at about 80% across the waves. Note that this suggests that there is a high rate of adoption of preventative measures in South Africa. Kollamparambil & Oyenubi (2020) reports that the proportion of those who change their behaviour in response to COVID-19 is estimated to be 92% and 99.7% in waves 1 & 2 respectively. This high adoption rate is not driven by risk perception otherwise one would have expected a lower adoption rate (in wave 1). Perhaps government mandate on preventative measures encourages even those who don't perceive the risk to adopt the measures.

Figure 2, shows what this translates to in terms of the four attitudinal groups. There is a 10% increase in the proportion of the population that are responsive between waves 1 and 2. Across the waves, those with positive risk perception are more likely to be in the responsive category (about 30%) relative to being in the avoidance category (less than 10%). On the other hand, those with non-positive risk perception are more likely to be in the proactive category (about 50%) relative to the indifference category (about 10%). In general, the groups with positive self-efficacy and low-risk perception (i.e. responsive and proactive) are in the majority and this is consistent with the high level of adoption of preventative measures in the country.

In terms of trends in health measures and attitudinal groups by socio-economic status, Table 3 show the concentration index (Erreygers, 2009) of the outcomes and the attitudinal groups across the 4 waves of NIDS-CRAM data. We use years of schooling as the ranking variable because household income is not available for wave 3 (we note that the result when household income per capita is used as the ranking variable is not substantively different from what is presented in Table 4).

Table 4: Concentration index for the outcome and key independent variables

	wave 1	wave 2	wave 3	wave 4
Self-assessed health	-0.1135***			-0.1322***
Self-assessed depressive symptoms		-0.0461***	-0.0121	
Attitudinal groups				
responsive	0.1322***	0.1370***	0.1414***	0.1320***
Avoidance	0.0150	0.0405***	0.0195	0.0304***
proactive	-0.0596***	-0.1081***	-0.1003***	-0.0752***
indifference	-0.0876***	-0.0695***	-0.0607***	-0.0873***

Source NIDS-CRAM waves 1 to 4
Author's calculations

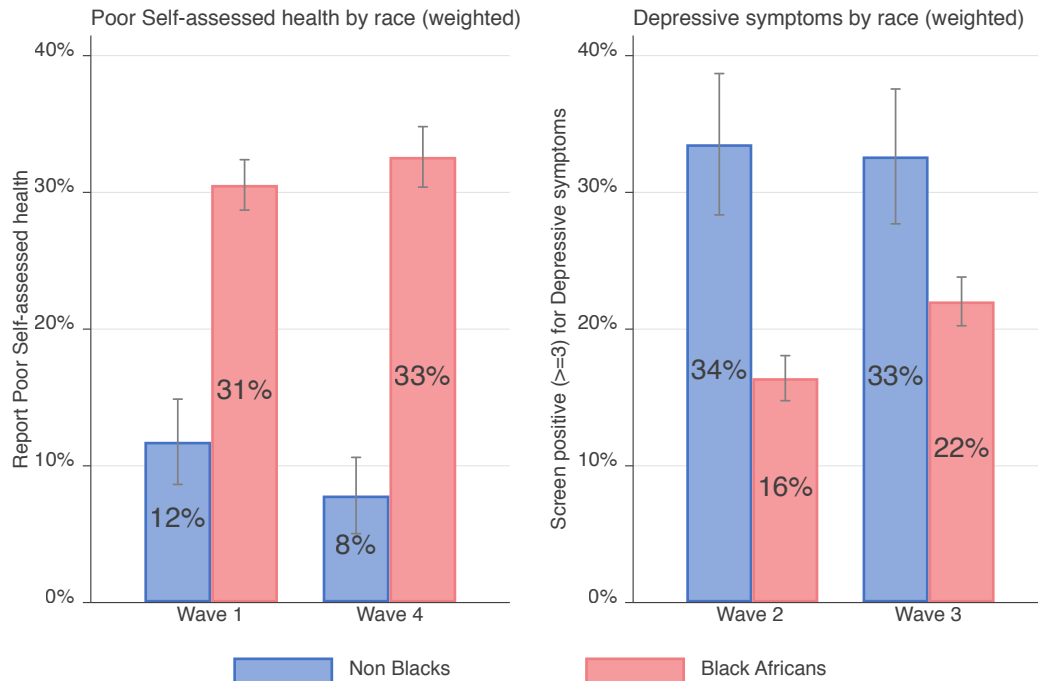
The result shows that poor self-reported health is more concentrated amongst the poor in waves 1 and 4. This is consistent with the result of Nwosu & Oyenubi (2021) who showed (using household income per capita) that inequality in poor health has increased during the pandemic compared to 2017. Our result confirms their result and shows that this pattern has not reverted. The concentration index also shows that depressive symptoms are concentrated amongst the poor in wave 2, however, this has weakened in wave 3 where depressive symptoms remain concentrated amongst the poor but the index is not statistically significant¹⁰. These patterns suggest that even though self-assessed health and depressive symptoms are expected to be correlated (Ambresin et al., 2014; Mavaddat et al., 2011)¹¹, the trajectory of the two measures diverge. While the income-health gradient in self-reported health appears to become steeper the gradient for depressive symptoms appear to have weakened. While this result (weakening of income health gradient in depressive symptoms) might be counterintuitive, it is consistent with other results in the literature. For example, the Axios-Ipsos poll conducted in the United States, show that a higher proportion of higher socio-economic status individuals report a decline in their emotional wellbeing due to the pandemic compared to those of lower socioeconomic status (Talev, 2020). Furthermore, an online survey conducted in South Africa shows that despite racial income inequality Black Africans reported significantly less psychological distress compared to other population groups earlier in the pandemic¹².

¹⁰ We note that this estimate is different from the one reported in an earlier report by Oyenubi & Kollamparambil (2020), however this is due to the way index is calculated. The earlier estimate is based on the subsample of wave 2 observation that matched with wave 5 NIDS data and the ranking variable is household income per capita (Oyenubi & Kollamparambil, 2020). However the substantive message that socio-economic health gradient in depressive symptoms has weakened over time remain consistent in the two papers.

¹¹ i.e. self-assessed health is the more general concept that encompasses physical and mental health while self-assessed depressive symptoms focuses on psychological health

¹² See <http://www.hsrc.ac.za/en/news/media-and-covid19/the-hidden-struggle> for a detailed report.

Figure 3: Distribution of poor health (PHQ-2 \geq 3 and SAH \geq 4) by wave



Source NIDS-CRAM waves 1 to 4
Author's calculations

Figure 3 shows this result clearly, while non-blacks are more likely to screen positive for depressive symptoms, blacks are more likely to report poor health.

The implication is the relationship between attitudinal groups and health outcomes may depend on the health outcome in question. Table 4 also show the results for the concentration indices for the different attitudinal groups. Responsive and avoidance are concentrated amongst individuals with higher socioeconomic status (proxied by years of education), while the converse is true for the group with non-positive risk perception (proactive and indifference). These results are consistent across the waves. It, therefore, appears that the idea that the cost of preventative measures is lowering self-efficacy amongst the poor is not consistent with our results. Specifically, having non-positive risk perception (proactive and indifference) tend to be concentrated amongst individuals of low socioeconomic status. This also suggests that the burden of depressive symptoms has increased for individuals with high socioeconomic status.

Main Results

As noted earlier under the EPPM these categories have implication for the adoption of preventative measures. However, our interest is in the relationship between these groups and health outcomes. For this analysis, we follow (Witte, 1992) by combining the groups with non-positive risk perception into one group (i.e. proactive and avoidance) and using this group as the base category. The implication is that we focus on how interacting self-efficacy with risk perception mediates the relationship between risk perception and health outcomes.

First, we ignore the attitudinal groups and present the results using risk perception and self-efficacy as separate independent variables. The result is presented in Table 5, the outcomes are self-assessed health (wave 4 & 1) and depression scores (wave 3 & 2). Note that in both cases higher value of the outcome implies worse health so that a positive beta estimate means a change in that variable is correlated with worse health. Lastly, Table 5A in the appendix presents similar result for the case where the model specification is consistent across waves. The result of Tables 5 & 5A are substantively similar suggesting that our inference is not influenced by the variables that are missing in different waves.

Table 5 shows that risk perception is positively correlated with worse health for both measures of health while self-efficacy is not significantly correlated with health. Therefore, even though risk perception is important for the adoption of preventative measures, it is also correlated with poor health.

Table 5: Ordered logit results of outcomes on risk perception and self-efficacy

VARIABLES	(1)	(2)	(3)	(4)
	Health# (wave 4)	Depression Score ^s (wave 3)	Depression scores ^s (wave 2)	Health# (wave 1)
Self-efficacy	-0.00 (0.11)	-0.04 (0.13)	-0.17 (0.14)	-0.21 (0.13)
Risk perception	0.47*** (0.09)	0.24*** (0.09)	0.21* (0.12)	0.26** (0.11)
Household Hunger	0.11 (0.18)	0.69*** (0.09)	0.61*** (0.14)	0.30** (0.12)
Household Income per capita	-0.00 (0.00)		0.00 (0.00)	0.00 (0.00)
Household size		0.04** (0.02)		
No of CSG received by the household	0.01 (0.02)	-0.04 (0.04)	0.01 (0.03)	-0.04 (0.03)
No of OAP received by the household	0.12 (0.08)	0.05 (0.07)	-0.04 (0.10)	0.01 (0.06)
Respondent receive any government grant	0.15* (0.09)	0.02 (0.09)	-0.05 (0.12)	0.04 (0.12)
Household income decrease	0.57** (0.23)	0.26 (0.16)	0.16 (0.17)	-0.06 (0.10)
Household income stay the same	0.34 (0.22)	-0.01 (0.16)	-0.19 (0.12)	
Informal settlement	-0.46** (0.23)	0.26 (0.28)	0.05 (0.31)	
Township	-0.12 (0.12)	0.23* (0.12)	0.07 (0.12)	
Formal residential	-0.14 (0.16)	-0.06 (0.14)	-0.06 (0.15)	
Farm	0.08 (0.18)	-0.17 (0.18)	-0.25 (0.17)	

Small holding	-0.46*	-0.05	0.30	
	(0.25)	(0.22)	(0.37)	
age	0.02	0.01	0.00	0.01
	(0.02)	(0.02)	(0.02)	(0.02)
age2	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
male	-0.14	0.02	-0.02	-0.18*
	(0.10)	(0.08)	(0.12)	(0.10)
Coloured	-1.74***	0.83***	0.83***	-1.20***
	(0.25)	(0.17)	(0.20)	(0.25)
Asian/Indian	-1.18***	0.49	-0.08	-0.92**
	(0.33)	(0.38)	(0.42)	(0.40)
White	-1.15***	0.65***	1.09***	-1.59***
	(0.20)	(0.22)	(0.25)	(0.19)
With a partner	0.04	-0.12	-0.01	
	(0.11)	(0.09)	(0.12)	
Trad/mud	0.25	0.02	-0.15	0.06
	(0.16)	(0.16)	(0.16)	(0.16)
Informal/shack	-0.03	0.34*	-0.27	-0.07
	(0.17)	(0.20)	(0.22)	(0.16)
Other	0.41	0.23	-0.42	0.63***
	(0.25)	(0.30)	(0.31)	(0.23)
Unemployed Discouraged	-0.35**	-0.26*	0.27	-0.22
	(0.16)	(0.15)	(0.18)	(0.15)
Unemployed Strict	0.13	0.20	0.61***	-0.46**
	(0.21)	(0.16)	(0.20)	(0.23)
Employed	-0.11	0.04	0.08	-0.31**
	(0.15)	(0.12)	(0.17)	(0.14)
Years of schooling	-0.03	0.08**	0.12**	0.03
	(0.05)	(0.04)	(0.05)	(0.04)
Years of schooling squared	-0.08	-0.31*	-0.49**	-0.36*
	(0.22)	(0.18)	(0.23)	(0.21)
No of preventative measures	-0.16***	0.05	0.01	-0.05
	(0.04)	(0.04)	(0.04)	(0.04)

/cut1	-1.96*** (0.52)	1.19*** (0.45)	0.85* (0.51)	-2.45*** (0.45)
/cut2	-0.42 (0.51)	1.88*** (0.45)	1.45*** (0.52)	-1.16*** (0.45)
/cut3	1.11** (0.51)	2.59*** (0.45)	2.17*** (0.52)	0.41 (0.45)
/cut4	2.67*** (0.53)	3.51*** (0.46)	3.17*** (0.52)	2.08*** (0.46)
/cut5		4.35*** (0.46)	3.97*** (0.53)	
/cut6		4.79*** (0.47)	4.40*** (0.55)	
Observations	4,728	5,122	3,817	4,062

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

*The health variable is coded as follows Excellent=5, Very good=4, Good=3, Fair=2, Poor=1

‡Depression scores ranges from 0 to 6 with higher scores indicating poorer health

Note that one plausible explanation for this is that there is reverse causality between risk perception and health such that poor health pre-pandemic is likely to be correlated with positive risk perception during the pandemic (Jacobs et al., 2010). However, we know that poor health (both in terms of self-assessed health and depressive symptoms) is concentrated amongst the poor pre-pandemic (Mukong et al., 2017). This means that if poor initial health is the reason for the correlation observed in *Table 5*, risk perception should be concentrated amongst the poor. Our result in *Table 4* and results elsewhere suggest that risk perception is concentrated amongst those of higher socioeconomic status (Kollampambil & Oyenubi, 2021). Although this is not a definitive explanation it suggests that much of what is reflected in *Table 4* may not be a result of poor health leading to positive risk perception. We consider further robustness check in the next section

As noted earlier psychological distress (during the pandemic) tend to be concentrated amongst the non-poor while poor self-assessed health is concentrated amongst the poor (during the pandemic). The multivariate result in *Table 5* shows that the relationship between race (which can be taken as a proxy for socioeconomic status in the South African context) and health outcome is such that being of black race is correlated with poorer self-assessed health. However, for depression, being of black race reduces the probability of reporting depressive symptoms. This result is consistent with *Table 4* in terms of the trajectory of inequality in the health measures across the waves of NIDS-CRAM.

Next, we consider how risk perception is correlated with health when it interacts with self-efficacy, the result is presented in *Table 6*. *Table 6A* in the appendix present the result when the model specification is identical across waves. Similar to *Table 5A* the result in *6A* is substantively similar to the one discussed here. Note that the base category is the responsive category, the result shows that being in the low-risk perception category (proactive/indifference) reduces the probability of reporting worse health outcomes (this relationship is not statistically significant in wave 3 but remain negative). In waves 3, 2 and 1 being in the avoidance category is not statistically different from being in the responsive category when it comes to health. However, in wave 4, being in the avoidance category is associated with worse self-assessed health when compared with being in the responsive category. Wave 4 result suggests that when risk perception is not balanced with self-efficacy the relationship between risk perception and self-assessed health is stronger than when the perception of risk and efficacy are balanced (*Table 6A* in the appendix confirms this result and show that the relationship is valid for wave 1 when the set of covariates are identical). We note that we did not find a similar relationship between being in the avoidance category and depressive symptoms.

Table 6: Ordered logit results of outcomes on the attitudinal groups

VARIABLES	(1) Health# (wave 4)	(2) Depression Score\$ (wave 3)	(3) Depression scores\$ (wave 2)	(4) Health# (wave 1)
avoidance	0.37** (0.16)	-0.12 (0.21)	0.28 (0.22)	0.30 (0.27)
Proactive/indifference	-0.42*** (0.10)	-0.26*** (0.10)	-0.16 (0.13)	-0.21** (0.11)
Household Hunger	0.11 (0.17)	0.69*** (0.09)	0.62*** (0.14)	0.29** (0.12)
Household Income per capita	-0.00 (0.00)		0.00 (0.00)	0.00 (0.00)
Household size		0.04** (0.02)		
No of CSG received by the household	0.01 (0.02)	-0.04 (0.04)	0.01 (0.03)	-0.04 (0.03)
No of OAP received by the household	0.11 (0.08)	0.05 (0.07)	-0.04 (0.10)	0.01 (0.06)
Respondent receive any government grant	0.14 (0.09)	0.01 (0.09)	-0.06 (0.12)	0.04 (0.12)
Household income decrease	0.56** (0.23)	0.26 (0.16)	0.16 (0.17)	0.07 (0.10)
Household income stay the same	0.34 (0.22)	-0.01 (0.16)	-0.20 (0.12)	
Informal settlement	-0.47** (0.22)	0.27 (0.28)	0.04 (0.31)	
Township	-0.13 (0.12)	0.22* (0.12)	0.07 (0.12)	
Formal residential	-0.14 (0.15)	-0.06 (0.14)	-0.06 (0.15)	
Farm	0.08 (0.18)	-0.17 (0.18)	-0.26 (0.17)	
Small holding	-0.45* (0.25)	-0.05 (0.22)	0.29 (0.37)	
age	0.02 (0.02)	0.01 (0.02)	0.00 (0.02)	0.01 (0.02)

age2	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
male	-0.15	0.02	-0.02	-0.17*
	(0.10)	(0.08)	(0.12)	(0.10)
Coloured	-1.74***	0.84***	0.84***	-1.20***
	(0.25)	(0.17)	(0.20)	(0.24)
Asian/Indian	-1.15***	0.49	-0.09	-0.91**
	(0.33)	(0.38)	(0.41)	(0.40)
White	-1.18***	0.66***	1.08***	-1.58***
	(0.20)	(0.22)	(0.25)	(0.19)
With a partner	0.03	-0.12	-0.01	
	(0.10)	(0.09)	(0.12)	
Trad/mud	0.25	0.02	-0.16	0.06
	(0.16)	(0.16)	(0.16)	(0.16)
Informal/shack	-0.03	0.34*	-0.27	-0.08
	(0.17)	(0.20)	(0.22)	(0.16)
Other	0.42	0.24	-0.44	0.63***
	(0.26)	(0.30)	(0.31)	(0.23)
Unemployed Discouraged	-0.35**	-0.26*	0.27	-0.22
	(0.16)	(0.15)	(0.18)	(0.15)
Unemployed Strict	0.13	0.20	0.61***	-0.46**
	(0.20)	(0.16)	(0.20)	(0.23)
Employed	-0.11	0.04	0.08	-0.31**
	(0.15)	(0.12)	(0.17)	(0.14)
Years of schooling	-0.03	0.08**	0.11**	0.03
	(0.05)	(0.04)	(0.05)	(0.04)
Years of schooling squared	-0.09	-0.31*	-0.48**	-0.36*
	(0.22)	(0.18)	(0.23)	(0.21)
No of preventative measures	-0.16***	0.04	0.01	-0.06
	(0.04)	(0.04)	(0.04)	(0.04)
/cut1	-2.40***	0.94*	0.83	-2.45***
	(0.52)	(0.49)	(0.54)	(0.48)
/cut2	-0.86*	1.63***	1.44***	-1.16**
	(0.52)	(0.49)	(0.54)	(0.48)

/cut3	0.67 (0.52)	2.34*** (0.49)	2.16*** (0.54)	0.41 (0.48)
/cut4	2.23*** (0.53)	3.26*** (0.50)	3.16*** (0.53)	2.09*** (0.49)
/cut5		4.10*** (0.49)	3.95*** (0.55)	
/cut6		4.54*** (0.50)	4.39*** (0.57)	
Observations	4,728	5,122	3,817	4,062

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

*The health variable is coded as follows Excellent=5, Very good=4, Good=3, Fair=2, Poor=1

^aDepression scores ranges from 0 to 6 with higher scores indicating poorer health

There are two important points related to the results presented in *Tables 5 & 6*. First, in *Table 5* where risk perception does not interact with self-efficacy, only risk perception is significant in explaining variation in health. However, *Table 6* reveals that being in low-risk groups (proactive/indifference) significantly reduces the probability of reporting poor health. This does not only reinforce the result of *Table 5* (i.e. positive risk perception is correlated with poorer health), it shows that including the indifference group does not change the result. Second, even though across models positive risk perception is significantly correlated with health, wave 4 result show that interacting risk perception with self-efficacy matters for self-assessed health. Wave 4 result suggests that when positive risk perception is not balanced with positive self-efficacy, the correlation between risk perception and health can be stronger.

The main point is that the interaction between risk-perception and self-efficacy does matter not only for the adoption of preventative measures under the EPPM but also for general and psychological health outcomes.

Robustness check

As noted earlier the relationship observed in *Tables 5 & 6* may be a result of reverse causality between health outcomes and risk perception. This calls for a more sophisticated method like instrumental variable to examine this proposition. In the absence of a valid instrument, we check this proposition by controlling for chronic illness as recorded in wave 1 (of NIDS-CRAM). The logic is that by definition chronic illnesses are conditions that last for a year or more and require ongoing medical attention or limit activities of daily living or both (CDC)¹³. The fact the chronic condition tends to last for at least a year means that those who reported chronic condition wave 1 (May/June 2020) are likely to still report chronic illness if this question was included in other waves. Since chronic illness is a physical condition excluding respondents that reported chronic illness in wave 1 should weaken the relationship between pre-existing health condition and risk perception. Therefore we re-estimate the result in *Table 6* for those who did not report chronic illness in wave 1. The result is shown in *Table 7* (note that we control for all the covariates controlled for in *Table 6*) and suggests that the pattern observed in *Table 6* still holds for the subgroup that did not report chronic illness in wave 1. The main difference is that being in the avoidance category is now significantly correlated with poor self-assessed health in wave 1. The implication is that excluding those with a chronic condition in wave 1 strengthen the result. While this does not rule out the possibility of reverse causality, it suggests that the relationship between the attitudinal groups and health outcome is likely not as a result of poor health leading to positive risk perception.

¹³ See <https://www.cdc.gov/chronicdisease/about/index.htm#:~:text=Chronic%20diseases%20are%20defined%20broadly,disability%20in%20the%20United%20States>

Table 7: Ordered logit results of outcomes on the attitudinal groups (excluding those who reported chronic illness in wave 1)

VARIABLES	(1) Health# (wave 4)	(2) Depression Score\$ (wave 3)	(3) Depression scores\$ (wave 2)	(4) Health# (wave 1)
avoidance	0.44** (0.19)	-0.19 (0.21)	0.37 (0.26)	0.57* (0.33)
Proactive/indifference	-0.31*** (0.11)	-0.23** (0.11)	-0.13 (0.15)	-0.11 (0.12)
Observations	3,808	4,181	2,929	3,125

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

*The health variable is coded as follows Excellent=5, Very good=4, Good=3, Fair=2, Poor=1

‡Depression scores ranges from 0 to 6 with higher scores indicating poorer health

Discussion & Conclusion

We examine the relationship between attitudinal groups (put forward under the EPPM) and health outcomes in South Africa during the COVID-19 pandemic. We start by exploring the evolution of health measures and attitudinal groups over the waves of NIDS-CRAM data. We found that the proportion of individuals in various attitudinal groups are stable over time except for the transition from wave 1 to 2 where the proportion of individuals with positive risk perception increased by 25%. The result also shows that the attitudinal groups predicted by the EPPM to reject the risk communication message (avoidance or indifference) constitute less than 20% of the population in every wave. This supports the notion that a lot of South Africans change their behaviour in response to COVID-19 with about 50% reported to engage in combination prevention i.e. adopt more than one preventative measure (Maughan-Brown et al., 2021).

Before the pandemic poor health (both self-assessed and psychological health) is concentrated amongst the poor. However, while self-assessed health has become more concentrated amongst the poor (over the waves of NIDS-CRAM), our result suggests that the income-health gradient in depressive symptoms has weakened (see *Table 4*). This is also manifested in the sign of the beta estimate for race in *Tables 5 & 6* (where being black African is negatively correlated with depression score while being positively correlated with poor self-assessed health). While this result does not conform with the expectation that the pandemic will exacerbate existing inequalities, similar results have been found elsewhere e.g. (Talev, 2020). Posel et al (2020) suggest that this might be a manifestation of the "steeling effect" (Holtge et al., 2018) among Africans. Steeling effect suggests that individuals who have experienced much worse past adversity may have acquired more resilience in dealing with negative events. Our result suggests that steeling effect, in this case, maybe sensitive to measure of health. While the trajectory of inequality in depressive symptoms suggest steeling effect, inequality in self-assessed poor health suggests that the pandemic has exacerbated inequality in health in general.

In our multivariate analysis, we found that positive risk perception is correlated with poor health across models. There is also an indication that the correlation between positive risk perception and poor self-assessed health is stronger for individuals in the avoidance category (i.e. those with positive risk perception with no self-efficacy) although this result is not consistent across health measures or waves of the data. The implication is that while positive risk perception may be seen as a positive in that it increases the probability of adopting preventative measures, it is also correlated with poor health (both psychological and general health). We argue that this relationship appears not

to be driven by reverse causality. This is because if risk perception is driven by poor pre-pandemic health one should expect risk perception to be pro-poor which is not the case. Furthermore, when the sample excludes those who live with chronic illnesses the negative relationship between positive risk perception and poor health did not weaken.

These results support the idea that careful consideration of risk communication is important because messages that focus on inducing higher risk perception (perhaps to foster the adoption of preventative measures) are not costless. Such messaging can inadvertently increase the proportion of individuals in the avoidance category or increase the prevalence of poor health (particularly psychological distress) in the population. This result also highlights the importance of targeted risk communication for a more effective response. A one size fits all kind of messaging that ignore the combination of risk perception/self-efficacy of different groups is likely to have adverse effects for some sections of the population. Specifically, high efficacy groups can receive messages that reinforce their efficacy beliefs while underscoring the risk they face, while low efficacy groups should receive messages that enhance prevention efficacy while addressing their risk perception (O'Hair & O'Hair, 2021). It should also be recognised that the cost of preventative measures can determine which group an individual ends up in given their socio-economic status.

Our results on the correlation between health measures and risk perception suggest that health recovery may be uneven. As vaccines become more accessible and the risk of COVID-19 becomes less of a threat we may see the income-health gradient in depressive symptoms (which disproportionately affect affluent groups) return to being pro-poor as it was before the pandemic. However, poor general health as measured by self-assessed health may not recover in the same manner. The trajectory of self-assessed health may have more to do with the downturn in the economic situation necessitated by the pandemic than concerns around COVID-19 itself (Oyenubi & Kollamparambil, 2020).

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Appendix

Table A1: Summary statistics for wave 2

Variable	Obs	Mean	Std. Dev.	Min	Max
depression					
0	3,817	0.494629	0.500037	0	1
1	3,817	0.143044	0.350164	0	1
2	3,817	0.141472	0.348554	0	1
3	3,817	0.123395	0.328934	0	1
4	3,817	0.047158	0.212003	0	1
5	3,817	0.013099	0.113715	0	1
6	3,817	0.037202	0.189281	0	1
Attitudinal groups					
responsive	3,817	0.352109	0.47769	0	1
proactive	3,817	0.478124	0.499587	0	1
avoidance	3,817	0.076238	0.265413	0	1
Hunger	3,817	0.178936	0.383349	0	1
Household income per capita	3,817	1600.778	4085.511	0	115000
No of Child Support Grants	3,817	1.529211	1.651106	0	11
No of Old Age Pensions	3,817	0.456379	0.664893	0	4
Receipt of any Govt grant	3,817	0.424417	0.494319	0	1
Household income change					
1. Increased	3,817	0.320671	0.466796	0	1
2. Decreased	3,817	0.156144	0.363039	0	1
3. Stayed the same	3,817	0.523186	0.499528	0	1
area2					
1. Traditional area/chiefdom	3,817	0.253864	0.435278	0	1
2. Informal settlement	3,817	0.037202	0.189281	0	1
3. Township	3,817	0.321195	0.466997	0	1
4. Formal residential	3,817	0.243647	0.429338	0	1
5. Farm	3,817	0.112392	0.315889	0	1
6. Small holding	3,817	0.0317	0.175224	0	1
7. Not Categorized	3,817	0.253864	0.435278	0	1
age	3,817	41.50773	15.79583	18	102
age2	3,817	1972.335	1523.466	324	10404
male	3,817	0.346869	0.476036	0	1

race					
1. African	3,817	0.847	0.360034	0	1
2. Coloured	3,817	0.091695	0.288633	0	1
3. Asian/Indian	3,817	0.010741	0.103096	0	1
4. White	3,817	0.050563	0.219133	0	1
With a partner	3,817	0.347393	0.476204	0	1
Dwelling type					
1. House/flat	3,817	0.746398	0.43513	0	1
2. Trad/mud	3,817	0.134399	0.341125	0	1
3. Informal/shack	3,817	0.091433	0.288262	0	1
4. Other	3,817	0.027771	0.164336	0	1
Employment status					
1. Not Economically active	3,817	0.25465	0.435722	0	1
2. Unemployed Discouraged	3,817	0.196489	0.397395	0	1
3. Unemployed Strict	3,817	0.129945	0.336287	0	1
4. Employed	3,817	0.418915	0.493446	0	1
Years of schooling	3,817	10.59392	4.095511	0	16
Years of schooling squared/100	3,817	1.29	0.777563	0	2.56
No of preventative measures	3,817	2.610165	1.106244	0	8
hhsz	3,817	5.307309	3.11975	1	25

Table A2: Summary statistics for wave 1

Variable	Obs	Mean	Std. Dev.	Min	Max
health					
1. Excellent	4,062	0.158543	0.365294	0	1
2. Very good	4,062	0.19547	0.396611	0	1
3. Good	4,062	0.348351	0.476506	0	1
4. Fair	4,062	0.219596	0.414024	0	1
5. Poor	4,062	0.07804	0.268268	0	1
Attitudinal groups					
responsive	4,062	0.244215	0.429674	0	1
proactive	4,062	0.605613	0.488779	0	1
avoidance	4,062	0.042836	0.202512	0	1
Household Hunger	4,062	0.27031	0.444175	0	1
Household income per capita	4,062	1640.956	3861.656	0	62500
No of Child Support Grants	4,062	1.392171	1.511042	0	9
No of Old Age Pensions	4,062	0.423191	0.673035	0	6
Receipt of any Govt grant	4,062	0.224274	0.417155	0	1
Household income change					
Stay the same/decreased	4,062	0.575086	0.494391	0	1
1. Increased	4,062	0.424914	0.494391	0	1
age	4,062	41.70753	14.96341	18	102
age2	4,062	1963.367	1448.069	324	10404
male	4,062	0.35352	0.478121	0	1
race					
1. African	4,062	0.833333	0.372724	0	1
2. Coloured	4,062	0.103151	0.304194	0	1
3. Asian/Indian	4,062	0.013786	0.116617	0	1
4. White	4,062	0.049729	0.217412	0	1
Dwelling type					
1. House/flat	4,062	0.765387	0.423809	0	1
2. Trad/mud	4,062	0.109306	0.312061	0	1
3. Informal/shack	4,062	0.112999	0.31663	0	1
4. Other	4,062	0.012309	0.110276	0	1

Employment status					
1. Not Economically active	4,062	0.224274	0.417155	0	1
2. Unemployed Discouraged	4,062	0.233629	0.423191	0	1
3. Unemployed Strict	4,062	0.131462	0.337947	0	1
4. Employed	4,062	0.410635	0.49201	0	1
Years of schooling	4,062	10.56696	4.124129	0	16
Years of schooling squared/100	4,062	1.286649	0.787585	0	2.56
No of preventative measures	4,062	2.129739	1.19926	0	7

Table 5A: Ordered logit results of outcomes on risk perception and self-efficacy

VARIABLES	(1) Health# (wave 4)	(2) Depression Score\$ (wave 3)	(3) Depression scores\$ (wave 2)	(4) Health# (wave 1)
Self-efficacy	0.04 (0.10)	-0.07 (0.13)	-0.18 (0.12)	-0.23** (0.10)
Risk perception	0.44*** (0.09)	0.26*** (0.09)	0.24** (0.10)	0.28*** (0.09)
Household Hunger	0.16 (0.16)	0.72*** (0.09)	0.69*** (0.13)	0.30*** (0.10)
Household size	0.03 (0.03)	0.02 (0.02)	-0.01 (0.02)	0.01 (0.02)
No of CSG received by the household	-0.01 (0.04)	-0.02 (0.03)	0.00 (0.04)	-0.03 (0.03)
No of OAP received by the household	0.13 (0.08)	0.09 (0.07)	-0.08 (0.09)	0.07 (0.05)
Respondent receive any government grant	0.16* (0.09)	0.02 (0.09)	-0.05 (0.10)	0.07 (0.09)
Household income decrease	0.27*** (0.10)	0.25*** (0.08)	0.24* (0.13)	0.04 (0.08)
age	0.02* (0.01)	0.01 (0.02)	0.01 (0.02)	0.04*** (0.01)
age2	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00*** (0.00)
male	-0.13 (0.09)	-0.02 (0.08)	-0.01 (0.10)	-0.07 (0.08)
Coloured	-1.70*** (0.21)	0.74*** (0.14)	0.82*** (0.14)	-1.41*** (0.17)
Asian/Indian	-1.17*** (0.31)	0.36 (0.37)	0.21 (0.27)	-0.91*** (0.33)
White	-1.21*** (0.16)	0.51** (0.20)	1.02*** (0.18)	-1.51*** (0.14)
Trad/mud	0.28* (0.15)	-0.09 (0.14)	-0.13 (0.13)	0.05 (0.13)

Informal/shack	-0.05 (0.18)	0.33* (0.17)	-0.18 (0.18)	0.04 (0.15)
Other	0.37* (0.20)	0.27 (0.28)	-0.43* (0.26)	0.77*** (0.28)
Unemployed Discouraged	-0.33** (0.16)	-0.17 (0.15)	0.26 (0.16)	-0.05 (0.12)
Unemployed Strict	0.12 (0.19)	0.32** (0.16)	0.41** (0.17)	-0.18 (0.14)
Employed	-0.18 (0.15)	0.17 (0.11)	0.01 (0.16)	-0.23** (0.11)
Years of schooling	-0.02 (0.04)	0.09*** (0.04)	0.07* (0.04)	0.01 (0.03)
Years of schooling squared	-0.14 (0.20)	-0.40** (0.17)	-0.25 (0.21)	-0.22 (0.16)
No of preventative measures	-0.15*** (0.04)	0.02 (0.04)	0.03 (0.04)	-0.05 (0.03)
/cut1	-1.84*** (0.42)	0.99*** (0.38)	1.00** (0.44)	-1.48*** (0.35)
/cut2	-0.37 (0.42)	1.67*** (0.38)	1.62*** (0.44)	-0.21 (0.34)
/cut3	1.18*** (0.42)	2.35*** (0.38)	2.30*** (0.44)	1.40*** (0.35)
/cut4	2.72*** (0.44)	3.27*** (0.39)	3.33*** (0.44)	3.03*** (0.35)
/cut5		4.09*** (0.39)	4.09*** (0.46)	
/cut6		4.50*** (0.39)	4.48*** (0.47)	
Observations	5,359	5,685	4,851	6,353

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

*The health variable is coded as follows Excellent=5, Very good=4, Good=3, Fair=2, Poor=1

‡Depression scores ranges from 0 to 6 with higher scores indicating poorer health

Table 6A: Ordered logit results of outcomes on the attitudinal groups (uniform specification)

VARIABLES	(1)	(2)	(3)	(4)
	Health (wave 4)	Depression (wave 3)	Depression (wave 2)	Health (wave 1)
Avoidance	0.27* (0.16)	-0.12 (0.20)	0.22 (0.18)	0.35* (0.21)
Proactive/indifference	-0.39*** (0.09)	-0.28*** (0.09)	-0.20* (0.11)	-0.22** (0.09)
Household Hunger	0.16 (0.16)	0.72*** (0.09)	0.69*** (0.13)	0.29*** (0.10)
Household size	0.03 (0.03)	0.02 (0.02)	-0.01 (0.02)	0.01 (0.02)
No of CSG received by the household	-0.01 (0.04)	-0.02 (0.03)	0.00 (0.04)	-0.03 (0.03)
No of OAP received by the household	0.13 (0.08)	0.09 (0.07)	-0.08 (0.09)	0.07 (0.05)
Respondent receive any government grant	0.15* (0.09)	0.02 (0.09)	-0.06 (0.11)	0.07 (0.09)
Household income decrease	0.27*** (0.10)	0.25*** (0.08)	0.24* (0.13)	0.04 (0.08)
age	0.02 (0.01)	0.01 (0.02)	0.02 (0.02)	0.04*** (0.01)
age2	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00*** (0.00)
male	-0.13 (0.09)	-0.02 (0.08)	-0.01 (0.10)	-0.06 (0.08)
Coloured	-1.70*** (0.21)	0.76*** (0.14)	0.83*** (0.15)	-1.40*** (0.17)
Asian/Indian	-1.15*** (0.30)	0.37 (0.37)	0.20 (0.27)	-0.90*** (0.34)
White	-1.24*** (0.16)	0.52*** (0.19)	1.02*** (0.18)	-1.51*** (0.14)
Trad/mud	0.28* (0.15)	-0.09 (0.14)	-0.14 (0.13)	0.05 (0.13)

Informal/shack	-0.06 (0.18)	0.33* (0.17)	-0.18 (0.18)	0.03 (0.15)
Other	0.36* (0.20)	0.28 (0.28)	-0.44* (0.26)	0.76*** (0.28)
Unemployed Discouraged	-0.33** (0.16)	-0.17 (0.15)	0.25 (0.16)	-0.04 (0.13)
Unemployed Strict	0.12 (0.19)	0.32** (0.15)	0.41** (0.17)	-0.18 (0.14)
Employed	-0.18 (0.14)	0.16 (0.11)	0.00 (0.16)	-0.23** (0.11)
Years of schooling	-0.02 (0.04)	0.09*** (0.04)	0.07* (0.04)	0.01 (0.03)
Years of schooling squared	-0.15 (0.20)	-0.39** (0.17)	-0.24 (0.21)	-0.21 (0.16)
No of preventative measures	-0.15*** (0.04)	0.01 (0.04)	0.03 (0.04)	-0.06* (0.03)
/cut1	-2.29*** (0.43)	0.74* (0.42)	0.95** (0.47)	-1.54*** (0.37)
/cut2	-0.82* (0.43)	1.42*** (0.42)	1.56*** (0.47)	-0.27 (0.36)
/cut3	0.73* (0.43)	2.10*** (0.42)	2.24*** (0.47)	1.34*** (0.36)
/cut4	2.27*** (0.45)	3.01*** (0.43)	3.28*** (0.46)	2.97*** (0.37)
/cut5		3.84*** (0.43)	4.03*** (0.48)	
/cut6		4.25*** (0.43)	4.42*** (0.50)	
Observations	5,359	5,685	4,851	6,353

For further information please see cramsurvey.org