Trust in government and its associations with health behaviour and prosocial behaviour during the COVID-19 pandemic

Qing Han, Bang Zheng*, Mioara Cristea, Maximilian Agostini, Jocelyn J Belanger, Ben Gutzkow, Jannis Kreienkamp, Anne Margit Reitsema, Jolien A van Breen, Georgios Abakoumkin, Jamilah Hanum Abdul Khaiyom, Vjollca Ahmedi, Handan Akkas, Carlos A Almenara, Anton Kurapov, Mohsin Atta, Sabahat Cigdem Bagci, Sima Basel, Edona Berisha Kida, Nicholas R Buttrick, Phatthanakit Chobthamkit, Hoon-Seok Choi, Sara Csaba, Kaja Damnjanović, Ivan Danyliuk, Arobindu Dash, Daniela Di Santo, Karen M Douglas, Violeta Enea, Daiane Faller, Gavan J Fitzsimons, Alexandra Gheorghiu, Ángel Gómez, Mai Helmy, Bertus F Jeronimus, Ding-Yu Jiang, Veljko Jovanović, Zeljka Kamenov, Anna Kende, Shian-Ling Keng, Tra Thi Thanh Kieu, Yasin Koc, Kamila Kovyazina, Inna Kozytska, Joshua Krause, Arie W Kruglanski, Maja Kutlaca, Nóra Anna Lantos, Edward P Lemay, Cokorda Bagus J Lesmana, Winnifred R Louis, Adrian Lueders, Najma Iqbal Malik, Anton P Martinez, Kira O McCabe, Jasmina Mehulić, Mirra Noor Milla, Idris Mohammed, Erica Molinario, Manuel Moyano, Hayat Muhammad, Silvana Mula, Hamdi Muluk, Solomiia Myroniuk, Reza Najafi, Claudia F Nisa, Boglárka Nyúl, Paul Anna O’Keefe, Jose Javier Olivas Osuna, Evgeny N Osin, Joonha Park, Gennaro Pica, Antonio Pierro, Jonas H Rees, Elena Resta, Marika Rullo, Michelle K Ryan, Adil Samekin, Pekka Santtila, Edyta Sasin, Birga M Schumpe, Heyla A Selim, Michael Vicente Stanton, Wolfgang Stroebe, Samiah Sultana, Robbie M Sutton, Eleftheria Tseliou, Akira Utsugi, Anne Marthe van der Bles, Caspar J Van Lissa, Kees Van Veen, Michelle R vanDellen, Alexandra Vázquez, Robin Wollast, Victoria Wai-lan Yeung, Somayeh Zand, Iris Lav Žeželj, Andreas Zick, Claudia Zúñiga, N Pontus Leander

* Correspondence to: Bang Zheng, Ageing Epidemiology Research Unit, School of Public Health, Imperial College London, London, UK. E-mail: b.zheng17@imperial.ac.uk.
| Author names                  | Affiliations                                                                 |
|------------------------------|-------------------------------------------------------------------------------|
| Qing Han                     | School of Psychological Science, University of Bristol, Bristol, UK           |
| Bang Zheng                   | Ageing Epidemiology Research Unit, School of Public Health, Imperial College  |
| Mioara Cristea               | Department of Psychology, Heriot Watt University, Edinburgh, UK              |
| Maximilian Agostini          | Department of Psychology, University of Groningen, Groningen, Netherlands    |
| Jocelyn J Belanger           | Department of Psychology, New York University Abu Dhabi, Abu Dhabi, United   |
| Ben Gutzkow                  | Department of Psychology, University of Groningen, Groningen, Netherlands     |
| Jannis Kreienkamp            | Department of Psychology, University of Groningen, Groningen, Netherlands     |
| Anne Margit Reitsema         | Department of Developmental Psychology, University of Groningen, Netherlands  |
| Jolien A van Breen           | Department of Psychology, University of Exeter, UK                           |
| Georgios Abakoumkin          | Laboratory of Psychology, Department of Early Childhood Education, University |
| Jamilah Hanum Abdul Khaiyom  | Department of Psychology, International Islamic University Malaysia, Malaysia|
| Vjolca Ahmedi                | Department of Pedagogy, Pristine University, Kosovo                         |
| Handan Akkas                 | Organizational Behavior, Ankara Science University, Turkey                   |
| Carlos A Almenara            | Faculty of Health Science, Universidad Peruana de Ciencias Aplicadas, Peru   |
| Anton Kurapov                | Department of Psychology, Taras Shevchenko National University of Kyiv, Ukraine|
| Mohsin Atta                  | Department of Psychology, University of Sargodha, Pakistan                   |
| Sabahat Cigdem Bagci         | Department of Psychology, Sabancı University, Turkey                        |
| Sima Basel                   | Department of Social Sciences, New York University Abu Dhabi, United States   |
| Edona Berisha Kida           | Faculty of Education, Pristine University, Kosovo                           |
| Nicholas R Buttrick          | Department of Psychology, University of Virginia, United States              |
| Phatthanakit Chobthamkit     | Department of Psychology, University of Kent, UK                            |
| Hoon-Seok Choi               | Department of Psychology, Sungkyunkwan University, Korea                     |
| Sara Csaba                   | Doctoral School of Psychology, ELTE Eötvös Loránd University, Hungary       |
| Kaja Damnjanović             | Department of Psychology, University of Belgrade, Serbia                     |
| Ivan Danyliuk                | Department of Psychology, Taras Shevchenko University, Ukraine              |
| Arobindu Dash                | Department of Psychology, International University of Business Agriculture & Technology (IUBAT), Bangladesh |
| Daniela Di Santo             | Department of Social and Developmental Psychology, University "La Sapienza", Rome, Italy |
| Karen M Douglas              | School of Psychology, University of Kent, UK                                |
| Violeta Enea                 | Department of Psychology, Alexandru Ioan Cuza University, Iasi, Romania      |
| Daiane Faller                | Center for global Sea Level Change, New York University Abu Dhabi, United Arab Emirates |
| Gavan J Fitzsimons           | Marketing and Psychology, Duke University, United States                    |
| Alexandra Gheorghiu          | Center for European Studies, Faculty of Law, Alexandru Ioan Cuza University, Romania |
| Ángel Gómez                  | Social and Organizational Psychology, Universidad Nacional de Educación a Distancia, Spain |
| Mai Helmy                    | Department of Psychology, Menoufia University, Egypt                        |
| Name                          | Institution                                                                 |
|-------------------------------|------------------------------------------------------------------------------|
| Bertus F Jeronimus            | Department of Psychology, University of Groningen, Netherlands               |
| Ding-Yu Jiang                 | Department of Psychology, National Chung-Cheng University                    |
| Veljko Jovanović              | Department of Psychology, University of Novi Sad, Serbia                    |
| Zeljka Kamenov                | Faculty of Humanities and Social Sciences, University of Zagreb, Croatia      |
| Anna Kende                    | Department of Social Psychology, Eötvös Loránd University, Hungary           |
| Shian-Ling Keng               | Division of Social Science, Yale-NUS College, Singapore                      |
| Tra Thi Thanh Kieu            | Department of Psychology, HCMC University of Education, Vietnam              |
| Yasin Koc                     | Department of Psychology, University of Groningen, Netherlands               |
| Kamila Kovyazina              | Independent researcher, Kazakhstan                                           |
| Inna Kozytska                 | Department of Psychology, Taras Shevchenko University, Ukraine              |
| Joshua Krause                 | Department of Psychology, University of Groningen, Netherlands               |
| Arie W Kruglanski             | Department of Psychology, University of Maryland, United States              |
| Maja Kutlaca                  | Department of Psychology, Durham University, University of Osnabrück, UK     |
| Nóra Anna Lantos              | Department of Social Psychology, ELTE Eötvös Loránd University, Hungary      |
| Edward P Lemay                | Department of Psychology, University of Maryland, United States              |
| Cokorda Bagus J Lesmana       | Department of Psychiatry, Udayana University, Indonesia                      |
| Winnifred R Louis             | School of Psychology, University of Queensland, Australia                    |
| Adrian Lueders                | Laboratoire de Psychologie Sociale et Cognitive, Université Blaise Pascal, France |
| Najma Iqbal Malik             | Department of Psychology, University of Sargodha, Pakistan                  |
| Anton P Martinez              | Department of Psychology, University of Sheffield, Argentina/UK              |
| Kira O McCabe                 | Psychology and Human Development,, Vanderbilt University, United States     |
| Jasmina Mehulić               | Faculty of Humanities and Social Sciences, University of Zagreb, Croatia      |
| Mirra Noor Milla              | Department of Psychology, Universitas Indonesia, Indonesia                   |
| Idris Mohammed                | Mass Communication, Usmanu Danfodiyo University Sokoto, Nigeria             |
| Erica Molinario               | Department of Psychology, University of Maryland, United States             |
| Manuel Moyano                 | Department of Psychology, University of Cordoba, Spain                      |
| Hayat Muhammad                | Department of Psychology, University of Peshawar, Pakistan                  |
| Silvana Mula                  | Dipartimento dei Processi di Sviluppo e Socializzazione, University "La Sapienza", Rome, Italy |
| Hamdi Muluk                   | Department of Psychology, Universitas Indonesia, Indonesia                   |
| Solomiia Myroniuk             | Department of Psychology, University of Groningen, Netherlands               |
| Reza Najafi                   | Department of Psychology, Islamic Azad University Of Rasht, Iran            |
| Claudia F Nisa                | Department of Psychology, New York University Abu Dhabi, United Arab Emirates |
| Boglárka Nyúl                 | Department of Social Psychology, ELTE Eötvös Loránd University, Hungary     |
| Paul Anna O’Keefe             | Division of Social Sciences, Department of Management and Organisation, Yale-NUS College, Singapore |
| Jose Javier Olivas Osuna      | Department of Political Science and Administration , National Distance Education University (UNED), United Kingdom/Spain |
| Evgeny N Osin                 | Department of Psychology, National Research University Higher School of Economics, Russia |
| Joonha Park                   | Graduate School of Management, NUCB Business School, Japan                   |
| Gennaro Pica                  | Dipartimento dei Processi di Sviluppo e Socializzazione, University "La Sapienza", Rome, Italy |
| Name                  | Institution                                                                 | Location                        |
|-----------------------|------------------------------------------------------------------------------|----------------------------------|
| Antonio Pierro        | Department of Social and Developmental Psychology, University "La Sapienza"  | Rome, Italy                      |
| Jonas H Rees          | Research Institute Social Cohesion, Institute for Interdisciplinary Research | University of Bielefeld, Germany |
| Elena Resta           | Dipartimento dei Processi di Sviluppo e Socializzazione, University "La    | Rome, Italy                      |
| Rullo                 | Department of Educational, Humanities and Intercultural Communication,       | University of Siena, Italy       |
| Michelle K Ryan       | 1) Department of Psychology, University of Exeter, UK; 2) Faculty of        | University of Groningen,         |
| Adil Samekin          | Psychology and Pedagogy, S. Toraighyrov Pavlodar State University, Kazakhstan| United Arab Emirates             |
| Pekka Santtila        | Department of Psychology, New York University Shanghai, United States       |                                  |
| Edyta Sasin           | Department of Psychology, New York University Abu Dhabi, United Arab        | Emirates                         |
| Birga M Schumpe       | Department of Psychology, New York University Abu Dhabi, United Arab        | Emirates                         |
| Heyla A Selim         | Department of Psychology, King Saud University, Saudi Arabia                |                                  |
| Michael Vicente       | Health Sciences, California State University, East Bay, United States        |                                  |
| Stanton               | Wolfgang Stroebbe                                                           | Department of Psychology,       |
| Anne Marthe van der  | Samiah Sultana                                                               | Department of Psychology,       |
| Bles                  | University of Groningen, Netherlands                                        | University of Groningen,        |
| Caspar J Van Lissa    | Department of Methodology & Statistics, Utrecht University, Netherlands      | Netherlands                      |
| Kees Van Veen         | Sustainable Society, University of Groningen, Netherlands                    |                                  |
| Michelle R vanDellen  | Department of Psychology, University of Georgia, United States              |                                  |
| Alexandra Vázquez     | Social and Organizational Psychology, Universidad Nacional de Educación a   | Spain                            |
| Robin Wollast         | Laboratory of Psychology, Department of Early Childhood Education, University|                                  |
| Akira Utsugi          | Graduate School of Humanities, Nagoya University, Japan                      |                                  |
| Anne Marthe van der  | Department of Psychology, University of Groningen, Netherlands              |                                  |
| Bles                  | Caspar J Van Lissa                                                           | Department of Methodology &     |
| Van Veen              | Wolfgang Stroebbe                                                           | Statistics, Utrecht University, |
| Kees Van Veen         | Samiah Sultana                                                               | Netherlands                      |
| Michelle R vanDellen  | Department of Psychology, University of Georgia, United States              |                                  |
| Alexandra Vázquez     | Social and Organizational Psychology, Universidad Nacional de Educación a   | Spain                            |
| Robin Wollast         | Laboratory of Psychology, Department of Early Childhood Education, University|                                  |
| Victoria Wai-lan Yeung| Department of Psychology, Lingnan University, Hong Kong, China              |                                  |
| Samayeh Zand          | Department of Psychology, Islamic Azad University Of Rasht, Iran            |                                  |
| Iris Lav Żeželj       | Department of Psychology, University of Belgrade, Serbia                    |                                  |
| Andreas Zick          | Institute for Interdisciplinary Research on Conflict and Violence (IKG),     | University of Bielefeld,        |
| Claudia Zúñiga        | Department of Psychology, Universidad de Chile, Chile                       | Germany                          |
| N Pontus Leander      | Department of Psychology, University of Groningen, Groningen, Netherlands   |                                  |
Abstract

Previous studies suggested that public trust in government is vital for implementations of social policies that rely on public's behavioural responses. This study examined associations of trust in government regarding COVID-19 control with recommended health behaviours and prosocial behaviours. Data from an international survey with representative samples (N=23,733) of 23 countries were analysed. Specification curve analysis showed that higher trust in government was significantly associated with higher adoption of health and prosocial behaviours in all reasonable specifications of multilevel linear models (median standardised $\beta$=0.173 and 0.244, $P<0.001$). We further used structural equation modelling to explore potential determinants of trust in government regarding pandemic control. Governments perceived as well organised, disseminating clear messages and knowledge on COVID-19, and perceived fairness were positively associated with trust in government (standardised $\beta$=0.358, 0.230, 0.055, and 0.250, $P<0.01$). These results highlighted the importance of trust in government in the control of COVID-19.
Introduction

In order to address the growing public health crisis created by the COVID-19 pandemic, governments across the world need to play an essential role in the prevention and control of the disease while mitigating its economic impact. Numerous countries have introduced responsive measures and regulations to prevent disease transmission (e.g., social distancing, handwashing, self-isolation) and stabilize the economy. However, effective implementation of these measures depends on a high level of compliance and support from the public.

Emerging theoretical and empirical evidence suggest that trust in government is crucial to public’s compliance with social policies that rely on their behavioural responses. As such, understanding the association between trust in government and the adoption of preventive behaviours and exploring various determinants of trust in government during the pandemic are important for the control of COVID-19.

Trust in government represents the confidence and satisfaction of people with government performance. It has been identified as a cornerstone of the political system, particularly in crises such as natural disasters, economic crises, or pandemics. Trust in government produces spontaneous sociability, which in turn leads to cooperative, altruistic, and extraterritorial behaviours in social activities. Previous studies demonstrated that the higher level of trust in government was associated with greater willingness to follow a range of government recommendations and prosocial behaviours, such as adopting preventive behaviours to avoid the swine flu, abiding mandated social distancing policies during the Ebola outbreak, getting vaccinated against seasonal influenza, and making economic sacrifice for the environment. More recently, a survey of 2250 residents in the UK during COVID-19 pandemic found that those who trust the government to control the pandemic were slightly more likely to follow the government regulations imposed during lockdown.

Compared with the general trust in government which has been shaped over a long time by
various historical, cultural, or political factors, this specific aspect of trust in government regarding the ability and efficacy of COVID-19 control could be more dynamic. Given the importance of maintaining public trust during the pandemic, there is an urgent need to identify the determinants of trust in government regarding COVID-19 control. The Organization for Economic Co-operation and Development (OECD) pointed out that reliability, responsiveness, openness, better regulation, fairness, and inclusive policy making are key areas for governments to gain public trust. In the context of the current pandemic, better regulation and organisation of government in the design and implementation of responsive measures that are well-adapted to local norms could increase public support and trust in government. In addition, the lack of transparency of government has been identified as one of the major elements that have caused the decline of trust in government. Lessons from the SARS pandemic in 2003 also highlighted the importance of transparency and timely and accurate communication. Furthermore, trust in government is influenced by the performance of the national economy and citizens' evaluations of the economy, with negative perceptions of the economy shown to promote greater distrust. Finally, perceived fairness which refers to being treated equally as other people in society could also lead to distrust in government, especially during crises.

Based on the theoretical background and empirical evidence, we conducted a large-scale international survey focusing on trust in government and behavioural responses from the public during the unprecedented COVID-19 pandemic. The aim of this study was twofold: a) to examine the associations between trust in government on COVID-19 and the adoption of health and prosocial behaviours that are crucial for pandemic control; and b) to explore potential determinants of the COVID-19 related trust in government, including government regulation, clear information or knowledge on COVID-19, economic status, and perceived fairness during the pandemic.
Results

Population characteristics and country-level descriptions

We used data from the PsyCorona project (https://psycorona.org/), a web-based survey that included 23,733 participants from 23 countries who are representative of the population in their country in terms of age and gender. These participants have completed the survey during April 10 to May 11, 2020, of whom 51% are women, 32%, 54%, or 14% are aged between 18-34, 35-64, or over 65 years, and 59%, 29%, or 12% have education level below, equivalent, or above Bachelor’s degree.

Data on COVID-19 related trust in government (three items, Cronbach’s $\alpha = 0.754$), adoption of personal health behaviours (three items, Cronbach’s $\alpha = 0.795$), and adoption of prosocial behaviours (eight items, Cronbach’s $\alpha = 0.906$) were analysed (Table 1). Of the three trust-related items, one directly measured trust in country government to take the right response measures, two measured trust of country’s ability to fight COVID-19 or its economic consequences. Since the government in all 23 sample countries plays a major role in pandemic control, public’s trust in country could reflect their trust in government towards COVID-19.

Two scatter plots were generated with country-level mean values of personal health behaviour items and prosocial behaviour items against mean values of public trust items (Figure 1). A positive correlation was observed between the country-level trust in government and prosocial behaviour ($r = 0.49$, $P = 0.017$), whereas no correlation was observed for the country-level health behaviour ($r = 0.01$, $P > 0.05$).

Specification curve analysis (SCA) for associations of trust in government with health behaviour and prosocial behaviour

Given the fact that there are multiple items on each measure and various analytical options
regarding covariate adjustment, it is difficult to select one optimal model specification without introducing subjective bias. Therefore, we used specification curve analysis to examine the individual-level association between trust in government and health behaviour or prosocial behaviour, which considers all reasonable model specifications to avoid subjective analytical decisions. Based on multilevel linear regressions with behaviour measures as dependent variable and country-level intercepts as random effect, multiple analytical options were tested. For each of the three constructs (i.e., trust, health behaviour, prosocial behaviour), relevant items were tested individually and in combination as mean score or through principal component analysis (PCA, Table 1). Results of PCA showed a single principal component with eigenvalue greater than 1 for all three constructs, which represents most variations of corresponding items. In addition, to account for potential confounding bias, three specifications were considered: no covariates, only adjusting for basic demographics (age, gender, and education level), or adjusting for a full set of covariates (see Methods). After combining three model specification factors (dependent variable, independent variable, and covariate adjustment), the total numbers of model specifications are 75 for trust in government and adoption of health behaviour (5 for trust × 5 for health behaviour × 3 for covariates), and 210 for trust in government and prosocial behaviour (5 for trust × 14 for prosocial behaviour × 3 for covariates).

All 75 model specifications for multilevel linear regression of COVID-19 related health behaviour on trust in government revealed significant positive association (maximum $P$ for single test $= 6 \times 10^{-5}$). The standardised $\beta$ coefficients and standard errors (SE) obtained for this association from all specifications are plotted in Figure 2, with a median standardised $\beta$ of 0.173 (median SE = 0.007). Similarly, the median standardised $\beta$ of 15 specifications with the single-item direct measure of trust in government as independent variable was 0.123 (median SE = 0.007). To test the overall hypothesis that stronger trust in government
regarding pandemic control was associated with higher compliance with recommended health behaviours, we used bootstrapping technique to perform joint significance tests. After creating a pseudo dataset where the null hypothesis is true (i.e., true $\beta = 0$; see Methods), the SCA was repeated on 1000 re-sampled datasets which resulted in the distributions of estimated median $\beta$ value and number of significant tests under the null hypothesis. Results of bootstrapped tests showed that the probability of having a median $\beta > 0.173$ or $< -0.173$ (i.e., stronger than in original SCA), or getting 75 significant tests by chance was below 0.001 when the null hypothesis is true.

Furthermore, the SCA visualised the influences of different analytical options on the effect estimates (Figure 2). The health behaviour of self-quarantine had a slightly weaker association with trust (median $\beta = 0.156$, median SE = 0.007) than washing hands more frequently or avoiding crowded space (median $\beta = 0.180$ or 0.176, median SE = 0.007). Not adjusting for covariates or only adjusting for basic demographics yielded similar effect estimates (median $\beta = 0.208$ or 0.201, median SE = 0.007 or 0.006), whereas adjusting for a full set of covariates showed a weaker independent effect of trust in government on adoption of health behaviour (median $\beta = 0.115$, median SE = 0.007).

As for the association between trust in government and COVID-19 related prosocial behaviour, all 210 model specifications of multilevel linear regression revealed significant positive association (maximum $P$ for single test $= 2 \times 10^{-16}$). The median standardised $\beta$ coefficient obtained from all specifications was 0.244 (median SE = 0.006; Figure 3). Bootstrapped tests with 1000 re-sampled datasets showed that, when the null hypothesis is true, the possibility of having a median $\beta > 0.244$ or $< -0.244$ (i.e., stronger than in original SCA), or getting 210 significant tests by chance was below 0.001. Therefore, the null hypothesis was rejected and the existence of the association between trust in government regarding pandemic control and willingness to adopt prosocial behaviour was confirmed.
As shown in Figure 3, trust of country’s ability to fight the economic consequences had a stronger association with adoption of prosocial behaviour (median $\beta = 0.265$, median SE = 0.006) than trust of country's ability to fight the coronavirus or trust in government to take right response measures (median $\beta = 0.225$ or $0.177$, median SE = 0.006). Similar to the situation in SCA for health behaviour, controlling for a full set of covariates resulted in a weaker independent effect of trust in government on prosocial behaviour (median $\beta = 0.197$, median SE = 0.007).

**Structural equation model (SEM) for potential determinants of COVID-19 related trust in government and behaviour**

After establishing the associations between trust in government and health and prosocial behaviours, we further built an integrated model with multilevel SEM to explore potential determinants of trust in government in the context of COVID-19 control. In this generalised SEM, associations of hypothesised determinants with trust in government, and their direct associations (not through trust in government) with health and prosocial behaviours were estimated based on multilevel linear regressions, with country-level intercepts as random effects. Three latent variables were created: overall trust in government regarding pandemic control which determined the three measured items, willingness to adopt recommended health behaviour which determined the three health behaviour items, and willingness to adopt prosocial behaviour which determined the eight prosocial behaviour items (Figure 4).

After controlling for potential confounding variables (age, gender, education level, religion, citizenship, and close relationship with infected patients), the overall trust in government regarding pandemic control was positively associated with willingness to adopt recommended health and prosocial behaviours (standardised $\beta = 0.206$ and $0.378$, SE = 0.030 and 0.039; $P < 0.001$), which further supported the findings from the SCA models (Figure 4). As for the hypothesised determinants, governments being well-organised in response to the
pandemic, more fairness, more clear messages received on coping with COVID-19, and more knowledge on COVID-19 were associated with higher level of overall trust in government (standardised $\beta = 0.358, 0.250, 0.230, \text{ and } 0.055$, $SE = 0.019, 0.027, 0.026, \text{ and } 0.019; P < 0.01$). In contrast, employment status and personal financial strain were not significantly associated with overall trust in government regarding pandemic control (standardised $\beta = -0.012$ and $-0.007$, $SE = 0.009$ and $0.013; P > 0.05$). The fitting indices demonstrated an acceptable fit between this SEM and the data (root mean square error of approximation $= 0.038$, standardised root mean square residual $= 0.026$, comparative fit index $= 0.846$). The sensitivity analyses without adjusting for potential confounding variables or using the single-item direct measure of trust in government yielded similar results.

Furthermore, perceived knowledge and message clarity on COVID-19, fairness, and personal financial strain also had direct associations with willingness to adopt recommended health behaviour (standardised $\beta = 0.206, 0.153, -0.120, \text{ and } 0.047$, $SE = 0.018, 0.014, 0.014, \text{ and } 0.012; P < 0.001$). Governments being well-organised had direct association with prosocial behaviour (standardised $\beta = 0.069$, $SE = 0.026; P < 0.01$) but not health behaviour ($P > 0.05$). Besides, perceived knowledge and message clarity on COVID-19, fairness, and unemployment were directly associated with prosocial behaviour (standardised $\beta = 0.068, 0.052, -0.045, \text{ and } -0.046$, $SE = 0.020, 0.021, 0.015, \text{ and } 0.010; P < 0.05$).
Discussion

In this large-scale cross-country study focusing on COVID-19 related trust in government, we found a robust relationship between trust and personal preventive behaviour. A higher level of trust in government regarding COVID-19 control was significantly associated with higher compliance with measures of frequent handwashing, avoiding crowded spaces, and social isolation/quarantine. This result is consistent with previous findings that public trust was associated with adherence to public health interventions\textsuperscript{21,24-27}. Two representative surveys in Liberia and Congo during the Ebola outbreaks also indicated that trust in government was positively related to compliance with disease control measures\textsuperscript{12} or adoption of personal preventive behaviours (e.g., keeping social distance and accepting Ebola vaccines)\textsuperscript{28}. Conversely, it has been argued that the limited trust in government could make the control of COVID-19 more difficult, especially in low and middle income countries\textsuperscript{29}. The reduced acceptance of official information caused by distrust in government fosters the spread of fake news and misinformation\textsuperscript{4}, which could substantially affect the formation of people’s health behaviours.

In addition, our results showed a significant positive association between trust in government and willingness to engage in prosocial behaviours that aid the control of COVID-19 pandemic. This is in line with a number of previous studies where higher levels of trust in government are related to more support for public welfare policies and willingness to sacrifice personal material interests\textsuperscript{30-32}. As hypothesised, in a low-trust environment, citizens will prioritize immediate and partial benefits\textsuperscript{33}, whereas high levels of trust towards the long-term benefits of public policies could produce spontaneous sociability that motivates the self-sacrifice of some immediate benefits\textsuperscript{7,34}. Our study further affirmed this statement in the context of the current public health crisis. Moreover, we found that the trust of fighting the economic consequences had a stronger association with prosocial behaviour compared with
trust on disease control, which is plausible because the reduction in people’s financial concern may increase their altruistic behaviours such as donation.

In the context of this worldwide pandemic, the international cooperation between governments and people all over the world is the key to stop the spreading of the coronavirus. Both personal preventive health behaviour and the prosocial behaviour that offers support for others are essential for fighting the COVID-19. In this regard, building public trust in government regarding disease control could serve as an effective strategy to achieve a better cooperation and compliance of COVID-19 related policies and interventions, and ultimately improve the prevention and control of this disease.

Given the importance of trust in government on COVID-19, we further explored its determinants which are modifiable for a better translation into public policies. Results showed that government that was perceived as well organised in response to COVID-19, clear messages and perceived knowledge on COVID-19, and perceived fairness were positively associated with trust in government. This implies that clear information such as the number of infected cases, the capacity of the healthcare system, and unambiguous health instructions that represent government transparency and effective communication are important in terms of maintaining public trust. In fact, a recent survey in the UK revealed a significant increase in the percentage of people who were concerned about false or misleading information about coronavirus from the government from April to May, 2020. Our result on perceived fairness is in line with previous studies that linked feelings of social inequality with less trust in government or public health institutes. Therefore, the fairness in the pandemic control should be treated with caution.

The strength of this study lies in its large and representative samples from diverse geographic regions worldwide, which is especially important in the investigation of trust in government.
Moreover, we collected information on potential confounding variables, as well as potential determinants of trust in government to shed light on practical implications. From a methodological perspective, this study expanded the application of SCA in a dataset with hierarchical structure by employing multilevel linear regressions with random intercept in all model specifications. In consideration that this is a cross-country survey, such methodological development is useful to avoid intra-group correlations while increasing statistical power for individual-level variables in SCA models.

Nevertheless, this study has several limitations. Due to the cross-sectional design of this study, causal inferences for the hypothesised determinants of trust in government and its behavioural impact on pandemic control need to be confirmed by future longitudinal studies with follow-up data. Furthermore, a more detailed investigation on different aspects or dimensions of COVID-19 related trust in government or health institutes, such as the trust of detection capacity, clinical pathways, or vaccination, is needed for a comprehensive understanding of this topic.

In conclusion, this study demonstrates that stronger trust in government on COVID-19 control is associated with higher willingness to adopt recommended health and prosocial behaviours. In addition, governments being better organised in response to the pandemic, more unambiguous messages received and perceived knowledge on COVID-19, and higher perceived fairness are associated with higher level of trust in government. Relevant public policies targeting to improve public trust in fighting the coronavirus and dealing with secondary consequences could hugely facilitate the control of the pandemic.
Methods

Data source. This study was based on cross-sectional data from the PsyCorona Survey on COVID-19 (Project website: https://psycorona.org). This 20-minute web-based survey, translated into 30 languages, aimed to investigate the psychological impact of the coronavirus spread. During April 10 to May 11, 2020, the PsyCorona Survey actively recruited representative samples from 23 countries. Participants were sampled online through Qualtrics’ panel management service, so that they are representative of the country’s general population in terms of gender and age. About 1000 participants were selected for each of the 23 countries (Argentina, Australia, Brazil, Canada, France, Germany, Greece, Indonesia, Italy, Japan, Netherlands, Philippines, Romania, Russia, Saudi Arabia, Serbia, South Africa, South Korea, Spain, Turkey, the United Kingdom, Ukraine, and the United States of America).

Ethical review. PsyCorona Survey was approved by the Ethical Committee of the University of Groningen and New York University Abu Dhabi: ecp@rug.nl (study code: PSY-1920-S-0390); irbnyuad@nyu.edu (study code: HRPP-2020-42). All participants gave informed consent before taking the survey.

Measures. This study focused on the measures of trust in government regarding COVID-19 control, adoption of recommended health behaviours, and willingness to engage in COVID-19 related prosocial behaviours (Table 1). Of the three items on trust in government, one was rated in 5-point scale from 1 (not at all) to 5 (a great deal) and two were in 7-point scale from -3 (strongly disagree) to 3 (strongly agree). All three items on health behaviour and eight items on prosocial behaviour were in 7-point scale from -3 (strongly disagree) to 3 (strongly agree).

In addition, information on a set of covariates were collected in the survey, including age group, gender, education level, citizenship, religion, close relationship with infected patients,
employment status, personal financial strain, perceived fairness, knowledge on COVID-19, clear messages received on COVID-19, and government being well-organised in response to the pandemic. Details of relevant items are displayed in Supplementary Table 1.

**Eligible participants.** A total of 24,261 participants selected from 23 countries completed the survey. We excluded participants with any missing values in items on trust in government, health and prosocial behaviours, age group, and gender, which resulted in a sample of 23,733 participants for this study (sample size of each country varies from 738 to 1159). Complete case analysis was used to deal with missing values on covariates in relevant analyses (each covariate had 0 to <1% missing values).

**Specification curve analysis (SCA).** Associations of trust in government with health and prosocial behaviours were examined. Since there are multiple items for each construct and various analytical options for testing the association, SCA was adopted which covers all reasonable model specifications. Three model specification factors were considered: 1) Dependent variable (health behaviour and prosocial behaviour were analysed separately; items on each construct were tested individually, or in combination as mean score or principal component score based on PCA); 2) Independent variable (items on trust in government were used individually, or in combination as mean score or principal component score); 3) Covariate adjustment (no covariates; only adjusting for age, gender, education level; or adjusting for a full set of covariates as mentioned above).

SCA was implemented based on multilevel linear regression, with country-level intercept as random effect. All variables in the regression models were standardised before implementation. After testing all model specifications, the median standardised β and median SE were used as summary statistics. Due to missing values in covariates, the sample sizes were 23,733, 23,693, and 23,406 for models with no covariates, with adjustment for age,
gender, education level, and fully adjusted models, in SCAs for health behaviour as well as for prosocial behaviour.

For the overall statistical inferences of SCA, a bootstrapping technique was used. A pseudo-dataset was created by replacing the original dependent variable with the residuals in each model specification, where the null hypothesis holds. Using random sampling with replacement, 1000 bootstrapped datasets of equal size as the pseudo-dataset were generated, on which 1000 repeated SCAs were conducted. The null hypothesis (i.e., no association between trust in government and behaviour) was rejected if the possibility of re-sampled median standardised β being larger in magnitude than observed value in original SCA was below 0.05, or the possibility of getting an equal or larger number of significant tests as in original SCA by chance was below 0.05.

**Structural equation model (SEM) analysis.** Associations between potential determinants of trust in government, latent variable of trust in government, and latent variables of health and prosocial behaviours were tested in generalised SEM analysis. Hypothesised determinants of trust in government regarding pandemic control include employment status (employed, not employed, or other), personal financial strain (in 5-point scale from -2 [strongly disagree] to 2 [strongly agree]), perceived fairness (in 5-point scale from -2 [strongly disagree] to 2 [strongly agree]), knowledge on COVID-19 (in 5-point scale from 1 [not at all knowledgeable] to 5 [extremely knowledgeable]), receiving clear messages on coping with COVID-19 (in 6-point scale from 1 [messages are completely unclear/ambiguous] to 6 [messages are very clear/unambiguous]), and government being well-organised in response to pandemic (in 6-point scale from 1 [not at all] to 6 [very much]; Supplementary Table 1). In addition, the SEM also serves as a complementary analysis to SCA by estimating the associations between latent variables of overall trust in government and willingness to adopt health and prosocial behaviours.
In the SEM analysis, country was controlled as random-intercept effects and other covariates were modelled as fixed effects. Standardised regression coefficients were estimated and tested in all linear regression models. Multiple fitting indices were calculated to evaluate the overall model fit.

All statistical analyses were conducted using R software (version 4.0.0). Codes for SCA were adapted from functions developed by Orben and Przybylski. The sem function of lavaan package was used for the SEM analysis. Where applicable, $P < 0.05$ indicates statistical significance.

Acknowledgments

We would like to thank all respondents of the PsyCorona Survey for providing the valuable data on COVID-19.

This study was funded by the University of Groningen (Sustainable Society & Ubbo Emmius Fund), the New York University Abu Dhabi (VCDSF/75-71015), and the Government of Spain (COV20/00086). The funders had no role in study design, data collection and analysis, decision to publish or preparation of the manuscript.

Competing Interests

The authors declare no competing interests.
**Tables and figures**

**Table 1. Items on trust in government, health behaviour, and prosocial behaviour with possible model specifications (analytical options)**

| Constructs                  | Items                                                                                                                                   | Analytical decisions                                                                 |
|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| **Trust in government**      | In general, how much do you trust the government of your country to take the right measures to deal with the coronavirus pandemic?   | Each item individually; mean of the three items; the first principal component of three items (which represents 68% of total variability). |
|                              | I think that this country is able to fight the coronavirus.                                                                             |                                                                                      |
|                              | I think that this country is able to fight the economic and financial consequences of coronavirus.                                     |                                                                                      |
| **Personal health behaviour**| To minimize my chances of getting coronavirus, I wash my hands more often.                                                              | Each item individually; mean of the three items; the first principal component of three items (which represents 69% of total variability). |
|                              | To avoid crowded spaces.                                                                                                                 |                                                                                      |
|                              | To put myself in quarantine.                                                                                                             |                                                                                      |
| **Prosocial behaviour**      | I am willing to help others who suffer from coronavirus.                                                                                | Each item individually; mean of the first four items (prosocial behaviour on disease control), the last four items (prosocial behaviour on economic consequence), or all eight items; the first principal component of the first four items, the last four items, or all eight items (which represents 60%, 72%, or 58% of total variability, respectively). |
|                              | I am willing to make donations to help others that suffer from coronavirus.                                                              |                                                                                      |
|                              | I am willing to protect vulnerable groups from coronavirus even at my own expense.                                                         |                                                                                      |
|                              | I am willing to make personal sacrifices to prevent the spread of coronavirus.                                                            |                                                                                      |
|                              | To help with the economic and financial consequences of coronavirus, I am willing to help others who suffer from such consequences.         |                                                                                      |
|                              | To help with the economic and financial consequences of coronavirus, I am willing to make donations to help others that suffer from such consequences. |                                                                                      |
|                              | To help with the economic and financial consequences of coronavirus, I am willing to protect vulnerable groups from such consequences, even at my own expense. |                                                                                      |
|                              | To help with the economic and financial consequences of coronavirus, I am willing to make personal sacrifices.                             |                                                                                      |
Figure 1. Scatter plots of country-level mean values of personal health behaviour items (A) and prosocial behaviour items (B) against mean values of trust in government items.

23 countries from the five continents are displayed as circles in each plot. Each colour corresponds to a particular continent. Three items on trust in government were harmonised into 7-point scale from -3 (strongly disagree) to 3 (strongly agree); three items on health behaviour and eight items on prosocial behaviour were in similar scale from -3 to 3.
Figure 2. Results of specification curve analysis for trust in government and adoption of personal health behaviour.

The standardised $\beta$ coefficients for the association of trust in government with health behaviour obtained from all 75 specifications (listed on x axis) are plotted at the upper half of the graph. Each point represents the $\beta$ coefficient of one specification, and the error bar (in grey) represents the corresponding standard error. The dotted line indicates the median standardised $\beta$ coefficient ($\text{median } \beta = 0.173$, median standard error = 0.007, median sample size = 23,693). At the lower half of the graph, the corresponding specifications for each level of the three model specification factors are displayed as squares.
Figure 3. Results of specification curve analysis for trust in government and adoption of prosocial behaviour.

The standardised $\beta$ coefficients for the association of trust in government with prosocial behaviour obtained from all 210 specifications (listed on x axis) are plotted at the upper half of the graph. Each point represents the $\beta$ coefficient of one specification, and the error bar (in grey) represents the corresponding standard error. The dotted line indicates the median standardised $\beta$ coefficient (median $\beta = 0.244$, median standard error = 0.006, median sample size = 23,693). At the lower half of the graph, the corresponding specifications for each level of the three model specification factors are displayed as squares.
Figure 4. Results of structural equation model analysis.

Only paths with significant regression coefficients ($P < 0.05$) are plotted. Standardised $\beta$ coefficients are displayed on the lower-right side of the corresponding paths. Trust 01-03 refer to the three items of trust in government; HB 01-03 refer to the three items of health behaviour; PB 01-08 refer to the eight items of prosocial behaviour.
References

1. World Health Organisation. Coronavirus disease (COVID-19) advice for the public. https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public (2020).

2. Anderson, R. M., Heesterbeek, H., Klinkenberg, D. & Hollingsworth, T. D. How will country-based mitigation measures influence the course of the COVID-19 epidemic? Lancet 395, 931-934 (2020).

3. Chanley, V. A., Rudolph, T. J. & Rahn, W. M. The origins and consequences of public trust in government - A time series analysis. Public Opin. Quart. 64, 239-256 (2000).

4. Lau, L. S. et al. COVID-19 in humanitarian settings and lessons learned from past epidemics. Nat. Med. 26, 647-648 (2020).

5. The Organization for Economic Co-operation and Development. Trust and Public Policy: How Better Governance Can Help Rebuild Public Trust. (OECD Publishing, 2017).

6. Bouckaert, G. & Van de Walle, S. Comparing measures of citizen trust and user satisfaction as indicators of 'good governance': difficulties in linking trust and satisfaction indicators. Int. Rev. Adm. Sci. 69, 329-343 (2003).

7. Fukuyama, F. Trust: The Social Virtues and the Creation of Prosperity. (Free Press, 1995).

8. Hetherington, M. J. The political relevance of political trust. Am. Polit. Sci. Rev. 92, 791-808 (1998).

9. Zmerli, S. & Van der Meer, T. W. Handbook on Political Trust. (Edward Elgar Publishing, 2017).

10. Uslaner, E. M. The Oxford Handbook of Social and Political Trust. (Oxford University Press, 2018).

11. Rubin, G. J., Amlot, R., Page, L. & Wessely, S. Public perceptions, anxiety, and behaviour change in relation to the swine flu outbreak: cross sectional telephone survey. BMJ 339, b2651 (2009).

12. Blair, R. A., Morse, B. S. & Tsai, L. L. Public health and public trust: Survey evidence from the Ebola Virus Disease epidemic in Liberia. Soc. Sci. Med. 172, 89-97 (2017).

13. Verger, P., Bocquier, A., Vergelys, C., Ward, J. & Peretti-Watel, P. Flu vaccination
among patients with diabetes: motives, perceptions, trust, and risk culture - a qualitative survey. *Bmc Public Health* **18**, 569 (2018).

14 Taniguchi, H. & Marshall, G. A. Trust, political orientation, and environmental behavior. *Environ. Polit.* **27**, 385-410 (2018).

15 Moxham-Hall, V. & Strang, L. Public opinion and trust in government during a public health crisis. https://www.kcl.ac.uk/news/public-opinion-and-trust-in-government-during-a-public-health-crisis (2020).

16 Van Bavel, J. J. et al. Using social and behavioural science to support COVID-19 pandemic response. *Nat. Hum. Behav.* **4**, 460–471 (2020).

17 Welch, E. W., Hinnant, C. C. & Moon, M. J. Linking citizen satisfaction with e-government and trust in government. *J. Publ. Adm. Res. Theor.* **15**, 371-391 (2005).

18 O'Malley, P., Rainford, J. & Thompson, A. Transparency during public health emergencies: from rhetoric to reality. *B. World Health Organ.* **87**, 614-618 (2009).

19 Citrin, J. & Green, D. P. Presidential Leadership and the Resurgence of Trust in Government. *Brit. J. Polit. Sci.* **16**, 431-453 (1986).

20 Miller, A. H. & Borrelli, S. A. Confidence in Government during the 1980s. *Am. Polit. Quart.* **19**, 147-173 (1991).

21 Meredith, L. S., Eisenman, D. P., Rhodes, H., Ryan, G. & Long, A. Trust influences response to public health messages during a bioterrorist event. *J. Health Commun.* **12**, 217-232 (2007).

22 Simonsohn, U., Simmons, J. P. & Nelson, L. D. Specification curve: descriptive and inferential statistics on all reasonable specifications. *SSRN Electron. J.* https://doi.org/10.2139/ssrn.2694998 (2015).

23 Orben, A. & Przybylski, A. K. The association between adolescent well-being and digital technology use. *Nat. Hum. Behav.* **3**, 173-182 (2019).

24 O'Malley, A. S., Sheppard, V. B., Schwartz, M. & Mandelblatt, J. The role of trust in use of preventive services among low-income African-American women. *Prev. Med.* **38**, 777-785 (2004).

25 Mohseni, M. & Lindstrom, M. Social capital, trust in the health-care system and self-rated health: The role of access to health care in a population-based study. *Soc. Sci. Med.* **64**, 1373-1383 (2007).

26 Goold, S. D. Trust, distrust and trustworthiness - Lessons from the field. *J. Gen. Intern. Med.* **17**, 79-81 (2002).

27 Salmon, D. A., Dudley, M. Z., Glanz, J. M. & Omer, S. B. Vaccine Hesitancy Causes,
Consequences, and a Call to Action. *Am. J. Prev. Med.* **49**, S391-S398 (2015).

28 Vinck, P., Pham, P. N., Bindu, K. K., Bedford, J. & Nilles, E. J. Institutional trust and misinformation in the response to the 2018-19 Ebola outbreak in North Kivu, DR Congo: a population-based survey. *Lancet Infect. Dis.* **19**, 529-536 (2019).

29 Lloyd-Sherlock, P., Ebrahim, S., Geffen, L. & Mckee, M. Bearing the brunt of covid-19: older people in low and middle income countries. *BMJ* **368**, m1052 (2020).

30 Hetherington, M. J. & Husser, J. A. How Trust Matters: The Changing Political Relevance of Political Trust. *Am. J. Polit. Sci.* **56**, 312-325 (2012).

31 Rudolph, T. J. & Evans, J. Political trust, ideology, and public support for government spending. *Am. J. Polit. Sci.* **49**, 660-671 (2005).

32 Scholz, J. T. & Lubell, M. Trust and taxpaying: Testing the heuristic approach to collective action. *Am. J. Polit. Sci.* **42**, 398-417 (1998).

33 Gyorffy, D. Governance in a low-trust environment: The difficulties of fiscal adjustment in Hungary. *Europe-Asia Stud.* **58**, 239-259 (2006).

34 Murphy, K. The role of trust in nurturing compliance: A study of accused tax avoiders. *Law Human Behav.* **28**, 187-209 (2004).

35 Norris, P. Social capital and the news media. *Harv. Int. J. Press-Pol.* **7**, 3-8 (2002).

36 Worthy, B. More Open but Not More Trusted? The Effect of the Freedom of Information Act 2000 on the United Kingdom Central Government. *Governance* **23**, 561-582 (2010).

37 Fletcher, R., Kalogeropoulos, A. & Nielsen, R. K. Trust in UK government and news media COVID-19 information down, concerns over misinformation from government and politicians up. https://reutersinstitute.politics.ox.ac.uk/trust-uk-government-and-news-media-covid-19-information-down-concerns-over-misinformation (2020).

38 Alsan, M. & Wanamaker, M. Tuskegee and the Health of Black Men. *Q. J. Econ.* **133**, 407-455 (2018).

39 Bingenheimer, J. B. & Raudenbush, S. W. Statistical and substantive inferences in public health: Issues in the application of multilevel models. *Annu. Rev. Publ. Health* **25**, 53-77 (2004).