**Well-being during the COVID-19 pandemic and the role of social contact**

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**Introduction**

Social connections have a major impact on psychological and emotional well-being (Cacioppo & Hawkley, 2003), and social isolation and loneliness are risk factors for both poor mental and physical health (Cacioppo & Hawkley, 2003; Holt-Lunstadt et al., 2015). People with fewer social relationships have higher mortality risks (Holt-Lunstad et al., 2010). Social connectedness is a basic need for human beings, but people fulfil their social needs in many different ways (e.g. via friends, family, belonging to a group, work, social activities; Lindenberg, 1996, 2013; Ormel et al., 1999).

The COVID-19 pandemic can be considered a natural experiment of what happens when people are restricted in their social behavior. Stay-at-home orders are negatively associated with well-being (Barrett et al., 2021), and older people who experience a loss in mobility also experience a loss in well-being (Ziegler & Schwanen, 2011). Most research examines the potential negative effects of the pandemic on mental health, focusing on psychological symptoms and distress. Although negative mental health (psychological symptoms) and positive mental health (happiness and life satisfaction) are correlated, the presence of psychological symptoms does not preclude the possibility of happiness (Keyes, 2005). In fact, between 15% and 30% of individuals with mental health problems are able to preserve some level of well-being and functioning (e.g., Bos et al., 2016; Duckworth et al., 2005; Keyes et al., 2005; Palmer et al., 2014). In this study we therefore focus on happiness trajectories during the social restrictions of the COVID-19 pandemic, and especially those trajectories in which people are able to maintain a satisfactory level of happiness.

Social restrictions in general impact well-being negatively, but earlier studies mainly focused on the commonalities between people instead of on individual differences (e.g. Barrett et al., 2021). Some studies indicate individual differences in the relation between social restrictions and well-being, such as extraverts who suffered more than introverts from COVID-19 protective measures (Wijngaards et al., 2020). Individual differences could explain contradicting results regarding the well-being of people during the Covid-19 pandemic. An increase in psychological symptoms such as depression and anxiety has been reported (see Vindegaard et al., 2020 for a review), also directly related to the strength of restrictions and number of COVID-19 related deaths (Atzendorf & Gruber, 2021), and a decrease in happiness has also been observed (EHERO, 2020). However, several studies also report either no difference in well-being before and after the virus outbreak (Statistics Netherlands, 2021), or a decrease in depressive symptoms (Andersen et al., 2020). In this study we aim to investigate which trajectories of happiness can be observed during times of social restrictions, and whatdemographic, social or personal characteristicscharacterize these trajectories. Especially, we investigate whether some, and if so how many, people fare well during times of social restrictions, and what factors could explain this.

***RQ1****: What trajectories of happiness can be distinguished in times of social restrictions?*

We cluster our participants into groups with different happiness trajectories, for example trajectories with consistently low or consistently high happiness levels, and have a special interest in participants who experienced an increase in happiness. The proportion of each subgroup is estimated and these different trajectories are linked to (trajectories of) demographics, subjective personal characteristics, and social interaction. These associations allow us to characterize the specific clusters of happiness trajectories that we distinguish.

***RQ2:*** *Can happiness trajectories be characterized by demographic, social or personal characteristics?*

Previous work suggested the average happiness score in the Dutch population (scale 0-10) decreased from 7.5 (February 2020) to 6.3 at the end of March and early April 2020 ([EHERO](https://www.eur.nl/en/ehero/news/happiness-during-covid-19-dutch-population-less-happy-especially-parents-and-people-income), 2020), in about 65% of the respondents, while 23% remained stable, and 11% became more happy than before the COVID-19 pandemic. In the current proposal we cover several countries and extend upon estimates of such trajectories by characterizing cluster differences in terms of age, gender, education levels, and social contact.

**Theory**

Although the trajectory analysis is data driven, we do have expectations about the different happiness trajectories that we might find. Namely, we expect to distinguish between at least three different happiness trajectories.

Major life events can have strong effects on well-being and happiness, and although they can have lasting effects (Lucas et al., 2007, Luhmann et al., 2011), most people's cognitive and emotional reactions lessen with time. This process is called hedonic adaptation (Frederick & Loewestein, 1999). However, the rate with which people adapt to such experiences varies across individuals and across life events (Diener et al., 2009; Lucas et al., 2007; Luhmann et al., 2011; Specht et al., 2011). With regard to the COVID-19 pandemic, Buecker et al. (2020) showed that Germans felt slightly more lonely after pandemic-related measures were activated, but this increased loneliness decreased again after two weeks. A study in the PsyCorona dataset showed hedonic adaptation in terms of positive and negative affect to the government restrictions to mitigate the coronavirus over the first 12 weeks of the pandemic (Reitsema et al., in progress).

Therefore, we expect that the majority of people experienced a temporary decrease in happiness, but adjusted to the new situation. As our measurements started when the severity of social restrictions was increasing in most countries (March 2020), this will translate into a trajectory that starts with a decrease in happiness, but increases and then stabilizes after some time. The first trajectory is thus expected to be characterized by low happiness levels during the first measurement weeks, but higher stable happiness levels thereafter.

Adaptation to negative events is not always possible. For example some individuals' circumstances could have changed to such a large extent that they were not able to compensate for their loss in happiness in different ways. Think, for example, of people who lost their job due to COVID-19 and cannot easily find another job (Lucas et al, 2004), older adults who cannot fulfill their social needs because of being in a medical risk group (adhering even more to the social restrictions), or younger people whose social engagement is affected more by social restrictions as they have a higher number of less close social partners and derive more satisfaction from these (English & Carstensen, 2014; Wrzus et al., 2013).

Therefore, we also expect a group of people who experienced a decrease in happiness, but were not able to adjust to the new situation. This would translate to a trajectory with consistently low happiness levels. The second trajectory is thus expected to show consistently low happiness levels.

For some people, the social restrictions might have provided an opportunity to make positive changes. For example, they might have benefited from reduced environmental stimulation (Aron et al., 2012), or they might have experienced less stress as they had less obligations, or because they had few social interactions to begin with and were therefore less affected by social restrictions. For instance, introverts experienced less depressive symptoms after COVID-19 protective measures, while extraverts did not (Wijngaards et al., 2020).

Therefore, we also expect a group of people who did not experience a decline in happiness, but who might have even experienced increased happiness during the social restrictions. This would translate into a trajectory of consistently high happiness levels, as we started the measurements after the social restrictions were in place. The third trajectory is thus expected to show consistently high happiness levels.

Mental health is generally positively associated with social resources and with larger and more diverse social networks (Thoits, 2011; Uchino, 2009). Engaging in social contact, with family, friends, and even acquaintances, was positively associated with happiness in both cross-sectional (Diener & Seligman, 2002) and intensive longitudinal (e.g., diary, experience sampling, Sandstrom & Dunn, 2014) research. In contrast, perceived social isolation and loneliness are detrimental for mental health (Hawkley et al., 2010). Social restrictions might increase loneliness for some people as face-to-face contact is restricted, although the pandemic may have also brought on more opportunities for online connection. Face-to-face contact has been associated with reduced negative mental health changes, while online contact was associated with increased negative mental health changes due to the COVID-19 pandemic (Litwin & Levinsky, 2021). A previous study examining the protective effects of social resources in February and March 2020 (Marroquin et al., 2020) showed that although social resources were associated with fewer psychological symptoms, the presence of these resources did not fully eliminate the impact of social distancing. That is, stay-at-home orders and (private) social distancing were associated with increased symptoms of mental health problems, above and beyond the protective effects of social support and social network size.

For these reasons, we examine several kinds of social contact in relation to the different happiness trajectories, namely: the amount of social contact (face-to-face and online) with friends or relatives and with others, the times leaving the house, and the strength of the social restrictions (stringency).

Perceived social isolation and loneliness are detrimental for mental health (Hawkley et al., 2010). People higher in neuroticism might be less able to deal with the uncertainty of the pandemic. Additionally, knowing someone with corona might make people unhappy because they care and are afraid for the sick person, but people who do not know someone with corona might view the pandemic as less serious, and subsequently feel more unhappy about the restrictions. We therefore include the following subjective personal characteristics: satisfaction with relationships, loneliness, neuroticism, financial strain, knowing someone with COVID-19 virus.

We also included several demographics. First, we included gender. Research focusing on psychological symptoms and distress suggests that the pandemic might have a gendered impact. It is mostly female-dominated employment that is affected by social distancing (Adams-Prassl et al., 2020). Stay-at-home orders have increased household work and childcare, tasks that have been taken on more by women than by men. Additionally, domestic violence has increased which disproportionately affects females (Leslie et al., 2020).

Second, we include age. Younger people benefit more from more distant connections and generally spend more time in group contexts, which are restricted by the COVID regulations. The number of less close social partners ('weak ties') is higher for adolescents and young adults compared to older adults. Social networks increase in size in young adulthood and decline throughout later adulthood, with reductions seen primarily in the number of such weak ties (Wrzus et al., 2013). Relatedly, older adults derive more emotional satisfaction from contact with close ties such as family members and close friends (English & Carstensen, 2014). Social distancing during the COVID-19 pandemic primarily reduces contact with weak social ties, and would therefore disproportionately affect young adults' social life. However, loneliness increased more strongly for older people than younger people after pandemic-related measures were activated (Buecker, 2020).

Third, we include education and employment status. The pandemic brought on major economic changes, with increased unemployment, decreased work hours, and increased labor market inequalities (Beland et al., 2020). People with low education are more likely to lose their job due to the social restrictions. Such economic consequences can have a large impact on well-being.

Fourth, we include the living situation. People who live with children have to balance homeschooling with their normal activities, but people who live alone have less opportunities for social interaction, especially during social restrictions. Loneliness increased more strongly for parents than for people without children after pandemic-related measures were activated (Buecker, 2020).

Fifth, we include physical health. People with worse physical health are more dependent on others and for them the social restrictions might especially hinder contact (e.g. living in nursing homes).

Sixth, we include country and country of origin. For people that do not live in their country of origin, travel restrictions might hinder contact with their family/friends. A previous study (Reitsema et al., in progress) showed little variation between countries in the association between severity of social restrictions on the one hand and positive and negative affect on the other, but this included only the first weeks of the pandemic when stringency was still very similar for different countries. With more diverse stringency patterns, country differences might be larger.

**Methods**

**Data collection**

The PsyCorona research project is an international collaboration which aims to examine the psychological processes involved in the COVID-19 pandemic (see https://psycorona.org/). The research was approved by the Ethics Committees of the University of Groningen (PSY1920-S-0390) and New York University Abu Dhabi (HRPP-2020-42). The design of the dataset and procedure of the data collection can be found in Leander et al. (2020).

The study was launched in March 2020 with an initial cross-sectional survey to examine virus-related and lockdown-related behavior, cognition, emotion, and motivation, and this survey was followed by longitudinal assessments to examine change over time in these variables. The initial survey was available in English, Dutch, German, Arabic, Italian, French, and Spanish. Further translations of the survey and follow-up questionnaires were added as the network of international collaborators grew, and the survey is currently available in 30 languages.

The first wave was collected in the week of March 27, 2020. Weekly measures were collected until June, 2020. After June, measures were taken monthly. We take into account all measurements until March 2021 (in total 21 measurement waves). All participants filled out a baseline questionnaire when they first participated, which was also possible after the first wave. We decided to include all countries, as the first social restrictions happened around March 2020 all over the world (see also Supplement 1).

**Participants**

Participants were recruited to participate in the cross-sectional survey through both convenience sampling and representative sampling, with the latter strategy implemented to achieve national representativeness in key participating countries. This resulted in responses from approximately 60,000 participants globally. Participants were invited to participate in the subsequent longitudinal survey and received weekly (from March 2020 through June 2020) or later monthly (from July 2020 and currently ongoing [March 2021]) follow-up surveys via e-mail. Each follow-up assessment has typically received 4,000 responses. In total, about 5000 people participated in these weekly surveys.

An overview of the number of participants who filled out the happiness measure can be provided upon request.

Baseline: 63,495 participants

N for happiness variable

Baseline: 62,676 participants (March 2020)

W4: 8,030 (April)

W5: 7,364 (April/May)

W8: 5,356 (May)

W11: 4,950 (June)

**Open Science disclosure**

The data will become publicly available in 2021 (exact date unknown at the moment). Researchers can find the data online and work with the data themselves after it has become publicly available. For information about accessing the data in the meantime, contact the Psycorona team via [psycorona@rug.nl](mailto:psycorona@rug.nl). A codebook of the variables can be found here <https://osf.io/qhyue/>. An overview of projects working with the same data can be found on <https://www.researchgate.net/project/PsyCorona-2>

This study was preregistrated. The preregistration can be found on OSF via <https://osf.io/t4n39/?view_only=97301755123740f1b4d109139a97188c>. Changes that were made after preregistration are described in Supplement X.

**Measures**

An overview of all measured variables in the Psycorona study and when they are asked (how often) in table 1.

***Happiness***

***Social contact***

***Subjective personal characteristics***

***Demographics***

**Missing data**

We will only take participants into account who completed the (mandatory) baseline questionnaire and at least once filled out the happiness question in subsequent waves. Depending on the trade-off between the number of timepoints and the number of participants, we might exclude more people with a lot of missing variables on happiness. In that case we will also do a robustness check with the full sample. For example, the cut-off point will differ if only two participants replied to less than half of the questionnaires, or if this holds for more than half of all participants.

We will only include the variable “Living with” if people answer consistently over different waves, otherwise this will be set to missing.

We will include as many measurements as possible, but will provide robustness checks with complete data.

**Analytical strategy**

We first investigate the associations between demographics, social and personal resources, and happiness. We also perform a multi-level analysis with all variables predicting happiness, to examine how these variables associate with happiness in general and to check for between-country differences in happiness. We will use country as level 3 predictor, individual characteristics as level 2 predictor, and time-variant variables as level 1 predictors (we will use the time point measurements from the same weeks when happiness was measured). We will also include the average scores of the time-variant measurements per person as predictors at level 2.

To answer our research questions, we perform growth mixture modelling with happiness as the outcome variable, to distinguish different happiness trajectories. We will use the measurements from the same weeks when happiness was measured as level 1 predictors, and also include the average scores of the measurements per person as predictors at level 2. We link the demographics, subjective personal characteristics, and the social interaction variables to the different trajectories by including them as predictors.

We will use a latent basis growth model, this model allows for great flexibility in characterizing nonlinear patterns or shapes of change over time (Ram & Grimm, 2013). This method classifies individuals into classes based on similar patterns of responses. We will compute models for several different numbers of latent trajectories. To choose the final number of latent classes we will consider the fit of different growth mixture models on the Bayesian Information Criterion (BIC), Sample-Size Adjusted Bayesian Information Criterion (SSA-BIC), and Entropy. Among the information criteria, BIC is generally preferred (Nylund, Asparouhov, & Muthén, 2007), and lower values on BIC indicate a better model fit. Entropy represents the quality of classification of individuals into latent classes. Entropy values can range from 0 to 1, with higher scores indicating greater classification accuracy (Ram & Grimm, 2009). We are interested in latent classes that include at least 5% of participants. We will also consider the interpretability and robustness of the latent classes in choosing the final number of components/latent classes.

Missing data imputation: In our maximum likelihood approach to growth mixture modeling, missing data on the outcome variable are accommodated using full information maximum likelihood under missing at random assumptions (Little & Rubin, 1987).

We include the countries as known classes in the growth mixture modelling. We then use the known classes (the countries) as predictors for people's latent class membership and potentially also let coefficients vary across countries (or constrain all coefficients to be equal across countries and only differ across latent classes). We could then also test whether latent class membership differs across countries*.*

**Robustness checks**

First we will check to what extent the respondents of the subsample (weekly surveys) are comparable to the whole sample (baseline).

Next, we will perform a robustness check with only participants who filled out all the questionnaires of all waves, robustness checks without outliers.

Based on the results, we will likely zoom in on specific countries to get more insights into the results.

**Minimum effect size of interest**

We classified correlations (r) as very weak if between .00 and .29, weak between .30 and .49, moderate between .50 and .69, strong between .70 and .89, and very strong from .90 onwards (Mukaka, 2012).

Only estimates with alpha levels below .01 will be interpreted as significant in the regression analyses to avoid type I errors. A more conservative alpha level is recommended in evaluating the results of novel studies (Benjamin et al., 2018).

The best-fitting model will be chosen by comparing the fit of different growth mixture models on the Bayesian Information Criterion (BIC), Sample-Size Adjusted Bayesian Information Criterion (SSA-BIC), and Entropy. We will also consider the interpretability and robustness of the latent classes.

As we expect changes in well-being over time, we need some within-person variation in the happiness measure in order to use this variable to answer our research questions. Happiness is asked in a general way, still there are reasons to believe that the answer will differ within a few weeks. Happiness can change quite dramatically over time, especially if life-situations change (Fordyce, 1988).

Happiness is measured on a 10-point scale from 1 to 10, thus if people always fill out a 6, for example, this is seen as no variance. When someone answers a 6 in one wave, but a 7 in another wave, we consider this as meaningful variance in the happiness measure.

If the skewed distribution of happiness causes problems in the analyses (which we do not expect), we will consider robustness checks with the scores 0-4 in one category “<5”.

**Statistical power**

In growth mixture models, the accuracy of parameter and standard error estimates, and estimates of the number of mixture components is influenced by the true mixing ratios, residual structures, and the proportion of the total variance of the outcome that is explained by the covariates -- these properties are unknown a priori.

Luckily, these accuracies are mostly influenced by the number of individuals and the number of occasions (Diallo et al., 2017). With about 5000 participants and a number of occasions equal to 13 our study has high accuracy with regard to estimates of parameters, standard errors, and number of mixture components over a wide range of potential mixing ratios, residual structures, and proportions of the total variance of the repeated measures explained by the covariates (Diallo et al., 2017).

**Results**

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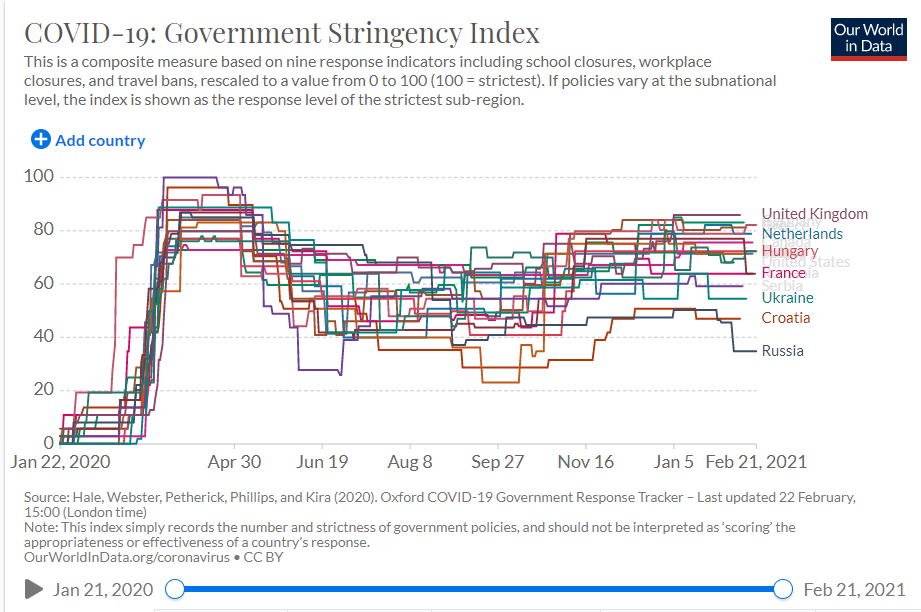
Table 1.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Wave | Measure | Scale | Variable |
| *Dependent variable* | | | | |
| Happiness | B, w4, w5, w8, w11 t/m 20 | In general, how happy would you say you are? | Extremely unhappy (1) - Extremely happy (10) | Scale, dependent variable |
| *Social interaction predictors* | | | | |
| Close contact | B, w1-20 | In the past 7 days, how many days have you had in-person (face-to-face) contact with friends or relatives? | 0-7 | Scale, level 1 predictor |
| Other contact | B, w1-20 | In the past 7 days, how many days have you had in-person (face-to-face) contact with other people in general? | 0-7 | Scale, level 1 predictor |
| Close online | B, w1-20 | In the past 7 days, how many days did you have online (video or voice) contact with friends or relatives? | 0-7 | Scale, level 1 predictor |
| Other online | B, w1-20 | In the past 7 days, how many days did you have online (video or voice) contact with other people in general? | 0-7 | Scale, level 1 predictor |
| Leave house | B, w1-20 | In the past week, how often did you leave your home? | I did not leave my home; Once or Twice; Three times; Four times or more | Ordinal, level 1 predictor |
| Leave house why | B, w1-20 | In the previous question, you have indicated that in the past week, you left the home at least once. What were the reasons for leaving your home? (Select all that apply) | I had to go to work; I had errands to run; Doing something for another person (e.g., helping with groceries); For leisure purposes with others (e.g., meeting up with friends, seeing family, going to the cinema etc.); For leisure purposes alone (e.g., running, going for a walk etc.); Other, please specify | Dummy per category, for possible post-hoc analyses |
| *Severity of social restrictions* | | | | |
| Stringency | Per day | Oxford government response tracker | https://www.bsg.ox.ac.uk/research/research-projects/coronavirus-government-response-tracker | Scale, level 1 predictor |
| *Subjective personal characteristics as predictors* | | | | |
| Satisfaction w. relationships | B, w1-20 | In general, how satisfied are you with your personal relationships? (baseline)  In the last week, how satisfied were you with your personal relationships? | Extremely unsatisfied (1) - Extremely satisfied (10 | Scale, level 1 predictor |
| Loneliness | B, w1-20 | During the past week, did you feel lonely? | Never (1) - All of the time (5) | Scale, level 1 predictor |
| Neuroticism | B, w6, w10, w12-20 | I see myself as someone who… ...is very concerned  ...easily gets nervous  ...is relaxed, can easily deal with stress | Strongly disagree (1) - Strongly agree (7) | Scale, level 2 predictor |
| Financial strain | B, w1-5, w9, w11-20 | Agree or disagree: I am financially strained | Strongly disagree (1) - Strongly agree (7) | Scale, level 1 predictor |
| Close Corona | B, w1-20 | Do you personally know anyone who currently has coronavirus (click all that apply) | Yes, myself; yes, a member of my family; yes, a close friend; yes, someone I know; yes, someone else; no, I don't know anyone | Yes/no, level 1 predictor |
| *Demographic predictors* | | | | |
| Gender | B (only) | What is your gender? | Female; Male; Other | Man/woman, level 2 predictor |
| Age | B (only) | What is your age? | 18-24; 25-34; 35-44; 45-54; 55-64; 65-75; 75-85; 85+ | Ordinal, level 2 predictor |
| Education | B (only) | What is your highest level of education? | Primary education; General secondary education; Vocational education; Higher education; Bachelors degree; Masters degree; PhD degree | Ordinal, level 2 predictor |
| Employment status | B, w1-5 w7, w11-20 | Which of the following categories best describes your employment status during the last month (baseline)/ week (other waves)? (Multiple may apply) | Employed, working 1-23 hours per week; Employed, working 24-39 hours per week; Employed, working 40 or more hours per week; Self-Employed; Not employed, looking for work; Not employed, not looking for work; Lost my employment in the last month (baseline)/week (other waves); Lost my employment in the past month (baseline)/ last week (other waves) as my job has become temporarily not available (e.g., restaurant worker, driver, etc.); Homemaker; Retired; Disabled, not able to work; Student; Volunteering; Other | Full-time,  Part-time,  Unemployed,  Looking for work, level 2 predictor |
| Living with | w1, w6, w10 | What is your current living situation? | I live alone; I live with other people | Dummy, level 2 predictor |
| Living with who | w1, w6, w10 | Please indicate who you currently live with (multiple may apply) | Spouse or romantic partner; mother; father; one or more children; one or more housemates; other, please specify | Dummy per category, level 2 predictor |
| Phys health | w1,  w5, w11-20 | How is your current physical health? | Terrible (1) - Excellent (10) | Scale, level 1 predictor |
| Country | B (only) | In which country do you currently live in? |  | Nominal, level 3 predictor |
| Country citizen | B (only) | Are you a citizen of this country? | Yes; No | Yes/no, level 2 predictor |
|  |  |  |  |  |

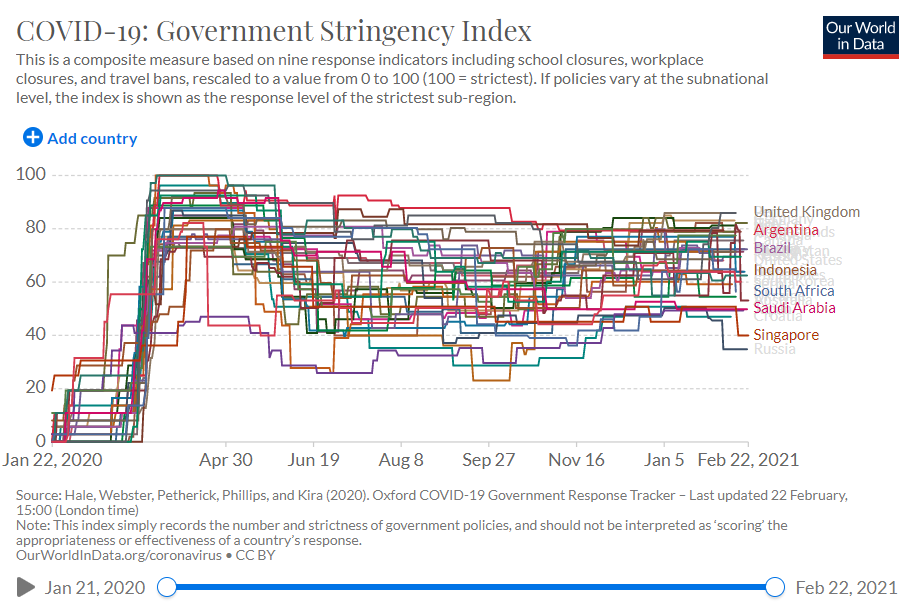
B = Baseline questionnaire, w1 = wave 1, N per wave ~5000

**Supplement 1**

Stringency (strength of restrictions) for Western countries (derived from https://ourworldindata.org):



Stringency for non-Western countries (with UK as comparison):



**Supplement X**

Changes in manuscript after preregistration