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Development of transmission-reducing behaviour adherence measure (TRAM) for monitoring and predicting transmission-reducing behaviours during the pandemic

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ABSTRACT

There is a need for a measure to monitor adherence to transmission-reducing behaviours (TRBs) during pandemics. An adherence measure can monitor current TRBs, assess change over time and, potentially, predict later behaviours. The TRB adherence measure (scale consisting of seven items) includes questions based on government behavioural directives in Scotland that were common internationally, i.e., physical distancing, face covering and hand hygiene. Data were collected weekly for 6 weeks at the beginning of the pandemic, including a later follow-up repeated measure of some participants, in 20-minute structured telephone surveys with a nationally representative random sample of adults in Scotland. A total of 2969 people completed the adherence items and were highly adherent. Confirmatory factor analysis supported a unidimensional scale (CFI = .95; TLI = .93; RMSEA = .08; SRMR = .08), although internal consistency was low (Cronbach's alpha = .49). The adherence score significantly predicted adherence to a validity test item ($\Delta R^2 = .114$, $F(1,2964) = 379.76$, $p < .001$). It also predicted adherence to TRBs later over and above personal habitual styles (Creature of Habit Scale: COHS). The adherence score has been developed for routine monitoring of adherence to TRBs during the COVID-19 pandemic. It can be used to predict future similar behaviours and adherence to other behaviours, although it may be necessary to explore adherence to the specific behaviours occasionally. Adherent behaviour for one TRB is likely to be associated with adherence to government directives to other TRBs. Importantly, these TRBs are likely to be crucial in reducing COVID-19 case numbers, as well as protecting against other infectious diseases including influenza and the common cold.

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COVID-19; transmission-reducing behaviours; adherence; behaviour; measure

Introduction

It is critical that governments have rapid and reliable evidence of population adherence to transmission-reducing behaviours (TRBs), such as physical distancing and wearing face coverings, to regularly monitor and continuously improve adherence to government

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directives. Having an adherence measure could help governments, by signalling locations or target groups that need support. Currently, COVID-19 case rates are used to determine guidelines. Assuming that increases in COVID-19 cases are caused by people not adhering to TRBs, thus, when an increase in cases is noticed, new stricter directives are often implemented (Scottish Government, 2021). While governments and public health agencies can explore the reasons for increases in case rates, for example, through contact tracing, the link between adherence to TRBs and increases in case rates is delayed because of the gap between time of infection and emergence of symptoms, which can be as long as 2 weeks (Lauer et al., 2020). An adherence measure could detect attenuated adherence to TRBs and identify where intervention might be needed before an increase in case rates emerges. As such, there is a need for a reliable and valid measure of adherence that can be rapidly and easily applied across general populations.

Any measure of adherence would need to be able to address a fluid situation of changing guidelines and mandates, and changes in mitigation behaviours. It would be useful to have a measure of adherence that accommodated a subset of TRBs that was also a reliable and valid indicator of all TRBs. Objective measures of some behaviours are available such as mobile location data to assess adherence to physical distancing. However, there are some important limitations to these data. Often these types of data cannot be linked to individual socio-demographic factors, which is a barrier to targeting particular groups. Furthermore, factors known to be predictive of adherence, such as risk perceptions and illness beliefs, are not available alongside the measure of behaviour. This precludes the development of evidence-based interventions to change adherence to TRBs via changes in those beliefs shown to be predictive of adherence (Ajzenman et al., 2020; Bourassa et al., 2020). The lack of information on predictive factors and the use of different ways to assess adherence might also explain why early studies on adherence to TRBs during the COVID-19 pandemic reported varying degrees of adherence (e.g. Clark et al., 2020; Harper et al., 2020; Plohl & Musil, 2020).

Despite the importance of monitoring adherence to TRBs, few measures are available that have been rigorously developed and evaluated. One notable exception is the measure of Toussaint and colleagues (Toussaint et al., 2020), who developed a measure of compliance with recommendations from the Centers for Disease Control in the USA. This measure contained two components, namely, 'clean' behaviours (e.g. cleaning surfaces, sanitising hands) and 'containing' behaviours (e.g. covering a cough, physical distancing). Other assessments often use single items or checklist counts for which reliability and validity are often unknown. Worldwide people were generally asked to adopt three types of behaviour, namely physical distancing, hand washing and wearing a face covering (Clark et al., 2020; Scottish Government, 2020). *Physical distancing*, which initially involved staying at home, later required people to keep a specified distance (e.g. 2 metres in Scotland) from people not living in their household (Scottish Government, 2020; Prem et al., 2020). *Hand washing* has been shown to reduce the incidence of infectious diseases (Bloomfield et al., 2007; Jumaa, 2005; Warren-Gash et al., 2013). *Wearing a face covering*, although initially a topic of debate (Greenhalgh et al., 2020; Lazzarino et al., 2020) was advised worldwide. Ideally, these behaviours should be captured in any measure of adherence. Therefore, we aimed to develop a measure of

TRBs that included these three types of behaviour. We explored the factor structure of such a measure and examined its ability to predict adherence to other TRBs. Finally, individual factors such as a general propensity towards habitual behaviours might explain a tendency to adopt and maintain adherence to TRBs, especially those TRBs for which habits might already exist, e.g., hand washing. Therefore, we examined the ability of the measure of adherence to account for adherence above and beyond the explanatory potential of habitual personal style (as measured by the Creature of Habit scale (COHS) (Ersche et al., 2017)).

The present study

We aimed to see if adherence to TRBs could be combined into a unidimensional score that could be used as a predictive measure. Whether the scale should include subscales was empirically assessed. Consequently, the present study had the following research questions:

(1) What is the optimal factor structure of a transmission-reducing behaviour adherence measure (TRAM)?

1a: Does a one-, two- or three-factor structure give the best fit to self-reported adherence to three types of TRB?
1b: What is the internal consistency of each factor structure?

(2) Does the pattern of adherence change over time (using the optimal factor structure for TRAM from RQ1)?
(3) Does TRAM predict a) another TRB assessed concurrently, and b) TRBs assessed 1 or 2 months later, c) adherence beyond personal habitual styles?

Methods

Participants and design

We used data from the CHARIS adherence project (CHARIS, 2020; Den Daas et al., 2020). CHARIS was a series of cross-sectional telephone surveys of a representative sample of the adult population of Scotland that measured self-reported adherence. Data were collected weekly for the first 6 weeks (the 3 June to 15 July 2021), and then fortnightly (to November 2021) (n = ~500 per data wave). Participants were recruited by the commercial polling company Ipsos MORI using random digit dialling.

The first 6 weeks of data were used to develop the TRAM measure (N = 2969). The ability of the TRAM to predict subsequent behaviour was assessed using self-reported adherence of people who first participated in two later data waves (August 13th to 26th, September 24th to October 7th, n = 1003) that included a longitudinal follow-up on October 22nd to November 4th of half of the participants (n = 489), for the timeline, see Figure 1.

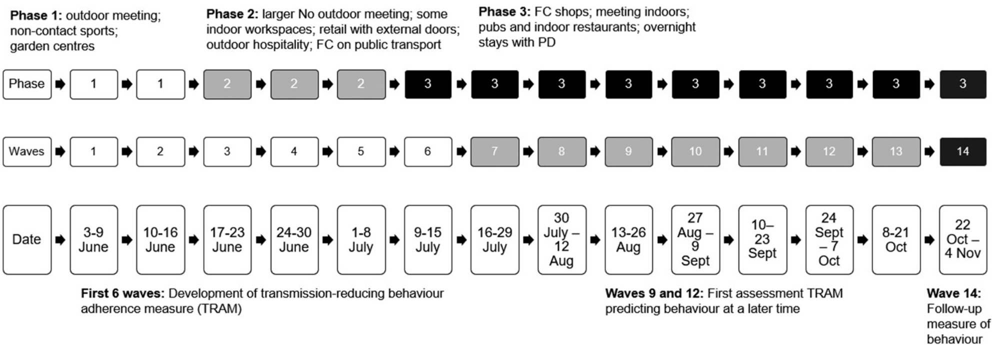

Figure 1. Overview of the timeline of the current study, including the contextual guideline developments.

Measures

Transmission-reducing behaviours

We assessed the extent to which people adhered to three types of TRBs, namely, physical distancing (one item), wearing a face covering (two items) and hand washing (four items, one item in the longitudinal follow-up, items and assessment times Supplementary Table S1). The TRB items were based on Scottish Government guidance with input from the CHARIS-consortium (a wider group of behavioural and health scientists drawn from Universities and Research Institutes across Scotland), and we engaged with two patient and public involvement (PPI) groups; the Scottish Health Council Public Engagement Group and the National Health Service Research Scotland Primary Care PPI group (Den Daas et al., 2020).

TRB measure to test the validity

The predictive validity of TRAM was tested against an additional TRB, namely, '*When you went out, it was only for permitted reasons (i.e., basic necessities, exercise)*'.

Creature of habit scale

Four items from the 27-item Creature of Habit scale (COHS) were relevant to TRBs; the items pertaining to eating behaviour were omitted (Supplementary Table 1; Ersche et al., 2017).

Data analyses

Confirmatory factor analyses (CFA) using R version 4.0.2 (package lavaan; Long, 1983) was used to assess the fit of a one-, two- and three-factor structure (RQ1a). The two-factor structure was based on the previously published two-factor 'contain and clean' measure [9] and the three-factor structure was based on the three types of TRBs (physical distancing, wearing face covering and hand washing). Maximum likelihood estimation with robust standard errors (MLR) was used, and factor intercorrelations were allowed.

For each model, fit was assessed using the comparative fit index (CFI), the Tucker–Lewis index (TLI), the root mean square error of approximation (RMSEA) and the standardized root mean square residual (SRMR). CFI and TLI values greater than .90, RMSEA values less than .10 and SRMR values less than .08 were taken to indicate a good model fit (Hu & Bentler, 1998). The internal consistency of each of the three-factor structure (RQ1b) was assessed using Cronbach's alpha. Using the preferred factor structure, we calculated the TRAM by weighting the adherence items for the total scale or the subscales (depending on the outcome of the factor analyses and reliability analyses) with their factor loading and then aggregated the results.

To assess whether the pattern of adherence changed over time (RQ2), we ran a linear regression with dummy codes of the weeks (reference = week 1) as the independent variable, and the TRAM as the dependent variable. We plotted the TRAM together with adherence to physical distancing, wearing face covering, and hand washing, by transforming them to Z-scores.

To assess whether TRAM could predict concurrent adherence to another COVID-19 TRB (RQ3a), we ran a linear regression with the TRAM, as an independent variable, and the concurrently measured validity test item as a dependent variable. We also ran a linear regression, with TRAM at time 1 and subsequent TRBs longitudinally measured at time 2 (RQ3b). Finally, we assessed whether TRAM could predict behaviour later, over and above the Creature of Habit Scale (COHS) (RQ3c). We added TRAM and the COHS in a hierarchical linear regression to assess whether COHS predicted adherence, and whether TRAM at time 1 predicted adherence at time 2, while controlling for COHS. All analyses were performed using IBM SPSS for Windows version 25 unless indicated otherwise.

Ethical approval

Ethical approval was granted by the Life Sciences and Medicine College Ethics Review Board (CERB) at the University of Aberdeen (CERB/2020/5/1942).

Results

Factor structure: Does a one-, two- or three-factor structure give the best fit to the data (RQ1a)?

Table 1 shows the means, standard deviations and factor loadings of the items. The CFA results indicated that the one-factor model demonstrated acceptable fit, supporting the unidimensional factor structure ($\chi^2(14) = 259.99$, $p < .001$; CFI = .95; TLI = .93; RMSEA = .08; SRMR = .08). The CFA for the two-factor solution resulted in similarly acceptable fit (χ^2 (13) = 188.31, $p < .001$; CFI = .97; TLI = .95; RMSEA = .07; SRMR = .07). The two 'containment' and 'clean' factors were correlated, r = .25, p < .001. The CFA for a three-factor solution was similarly acceptable (Chi-square (11) = 173.46, p < .001; CFI = .97; TLI = .94; RMSEA = .07; SRMR = .07). The factors were significantly and positively correlated, Physical distancing – Wearing face covering, r = .27, p < .001, Physical distancing – Hand washing, r = .29, p < .001 and Wearing face covering – Hand washing, r = 19, p < .001.

Table 1. Adherence TRBs item means and standard deviations.

Adherence to TRBs scale	Mean	Standard Deviation	Factor loadings – CFA 1 factor	Factor loadings – CFA 2 factors	Factor loadings – CFA 3 factors
Stayed 2 metres (6 feet) away from other people, except those who live in your household	4.53	0.88	.67	.75	.22
Wore face covering when you were in a shop	3.37	2.06	.54	.58	.85
Wore face covering when you travelled on public transport	5.70	1.06	.25	.27	.31
Washed your hands as soon as you got home	4.80	0.71	.84	.97	.97
When you washed your hands, you used soap and water	4.89	0.42	.23	.23	.23
When you washed your hands, you did this for at least 20 seconds	4.46	0.79	.41	.41	.41
Washed your hands before eating and drinking	4.45	0.85	.41	.40	.40

Note. Item mean scores range from 1 to 6.

Internal consistency (RQ1b)

Internal consistency of the one-factor scale was low, Cronbach's alpha .49. When 'not applicable', responses were removed from the data; an answer category people could choose if they had, for example, not travelled on public transport ('not applicable' responses were especially high for wearing face coverings, 70.8% and 33.4% of responses to items wearing face coverings on public transport and shops respectively), Cronbach's alpha increased to .58. Removing items did not improve internal consistency. The low internal consistency could be associated with a possible systematic effect of the 'non applicable' response to many items. However, the item-correlation matrix indicates that all items are significant and positively related to each other (Table 2), with the exception of wearing face covering.

Internal concistency of the 'contain' factor in the two-factor solution was .37 (excluding 'not applicable' responses increased $\alpha = .61$), and for the 'clean' factor, $\alpha = .51$ (alpha = .53 when 'not applicable' responses were excluded). For the three-factor, the 'clean' factor was the same as the hand washing factor, the 'contain' factor was separated into physical distancing (1 item – no internal consistency calculated) and wearing face covering (two items, internal consistency assessed with Pearson correlation, $r = .18$, $p < .001$).

The factor analyses and internal consistency data support the use of a one-factor scale.

Table 2. Item correlation matrix for items in the adherence scale. Significant p-values are indicated by * (<.05), ** (<.01), and *** (<.001).

	1	2	3	4	5	6
(1) Stayed 2 metres (6 feet) away from other people, except those who live in your household						
(2) Wore face covering when you were in a shop	.29***					
(3) Wore face covering when you travelled on public transport	.08***	.18***				
(4) Washed your hands as soon as you got home	.36***	.27***	.09***			
(5) When you washed your hands, you used soap and water	.05**	.01	.01	.12***		
(6) When you washed your hands, you did this for at least 20 seconds	.16***	.10***	.05*	.28***	.16***	
(7) Washed your hands before eating and drinking	.13***	.08***	.02	.31***	.09***	.25***

Descriptives and change in TRAM over time (RQ2)

Therefore, we calculated the TRAM score for the one-factor solution. The Median TRAM score was 14.96, interquartile range: 13.84–16.45. TRAM changed over time (Figure 2), compared to week 1, the TRAM score was higher in weeks 4, 5 and 6 (p's < .05), which coincided with wearing face covering becoming mandatory in public transport between week 3 and 4, $\Delta R^2 = .01$, $F(5,2949) = 8.34$, $p < .001$.

Concurrent predictive validity: predicting adherence to other TRBs from TRAM (RQ3a)

Using TRAM to predict the validation item showed that there was a significant association between the TRAM score and adherence to the validation TRB, $\Delta R^2 = .13$, $F(1,2951) = 439.59$, $p < .001$. As the TRAM score increases by one point, adherence to the validation TRB increased by 0.14 (Standardized Beta = .36, Standard Error = .01).

Predictive validity: using TRAM to predict later behaviours (RQ3b), over and above personal habitual styles (RQ3c)

Three univariate regression analyses showed that adherence to physical distancing, hand washing, and wearing face covering at time 1 were associated with TRAM at time 0, $F(1,460) = 68.41$, $p < .001$, $R^2 = 0.13$, $F(1,463) = 239.85$, $p < .001$, $R^2 = 0.34$ and $F(1,450) = 31.56$, $p < .001$, $R^2 = 0.07$, respectively. People who scored higher on TRAM had higher adherence at time 1, for each 1-point increase in TRAM adherence at time 1 increasing by 0.19 (physical distancing), 0.30 (hand washing) and 0.07 (wearing face covering).

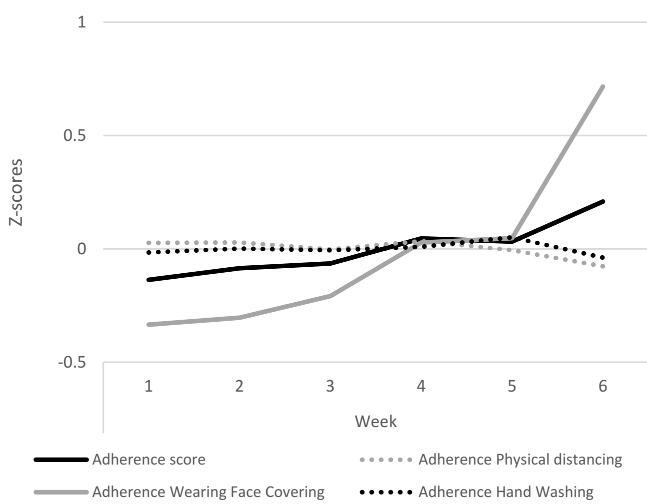

Figure 2. Adherence to the three behaviour types and the adherence score over time reflected by Z-scores to account for different scales.

In hierarchical regression analysis predicting adherence at time 1 using both TRAM (time 0) and COHS (time 1), only TRAM was significantly associated with adherence to each of the three TRBs (physical distancing, $F(2,458) = 34.23$, $p < .001$, $R^2 = 0.13$, $\Delta R^2 = .12$ (Beta TRAM = .19, $p < .001$, Beta COHS = 0.01, $p = .56$); hand washing, $F(2,461) = 119.82$, $p < .001$, $R^2 = 0.34$, $\Delta R^2 = .32$ (Beta TRAM = .31, $p < .001$, Beta COHS = −0.00, $p = .76$), and adherence to wearing face covering, $F(2,448) = 15.76$, $p < .001$, $R^2 = 0.07$, $\Delta R^2 = .06$ (Beta TRAM = .07, $p < .001$, Beta COHS = −0.00, $p = .80$)). In sum, TRAM predicted all three TRBs and predicted over and above a personal habitual style.

Discussion

It was statistically acceptable and useful to combine the three types of behaviour and seven specific TRBs into a single adherence score (TRAM), reflecting that people tend to keep their adherence to TRBs consistent with each other. TRAM can therefore be used for routine monitoring of population adherence to TRBs during the COVID-19 pandemic. TRAM can be used to monitor adherence over time, to assess factors that explain adherence, and to predict adherence to additional government restrictions or interventions (i.e. avoiding crowds, ventilation of spaces). TRAM confirmed that overall adherence to TRBs in Scotland is high (CHARIS, 2020; Nutt, 2020).

In a confirmatory factor analysis, all three solutions were similarly acceptable, with 2- and 3-factor solutions being marginally better than the one-factor solution. However, for monitoring puposes and overview of behaviour, we propose that the one-factor solution has benefits over multiple factor solutions and can be used. First, there is a minimum increase in the acceptability of the two-factor solution. Second, taking physical distancing together with wearing face covering above another combination was not reflected in the pattern of behaviours, as physical distancing correlated more strongly with hand washing (in another factor) than with wearing face covering (as also observed in Figure 2). Third, a simple one-factor solution is likely to be simpler to use in practice. However, for more fine-grained analyses, it could help to look into behaviour-specific patterns.

The predictive validity of the adherence score was also good, as the score was able to predict adherence to a TRB that was not included in TRAM. Moreover, TRAM predicted adherence to similar behaviours later. Importantly, the prediction of TRAM went beyond the prediction of personal habitual styles. Hence, adhering to TRBs as reflected in TRAM is not just being a person of habits, the predictive power stems from adhering to specific COVID-19 preventive behaviours.

Strengths and limitations

The strength of this study is that over the weeks it had a representative sample of adults living in Scotland. Participants were selected via random digit dialling, and participation did not rely on self-selection. Additionally, we applied telephone interviewing, people did not need access to a computer or internet, and they did not need to be high in literacy. Consequently, people from deprived areas and people who would normally be less likely to participate did take part. Therefore, our findings can be generalised to adults in Scotland.

Our results are based on self-report and limitations related to self-report are therefore relevant. In addition, people reported high adherence. Of course, these self-reports can be overestimations, and do not include quality of adherence. For example, did people wear masks correctly over their chins and noses, did people refrain from touching their face (covering) and did people wash their face covering after each wear?

Another limitation was the low internal consistency of TRAM. Items on wearing face covering did correlate poorly with other items, but removing them did not improve internal consistency. There are several potential explanations for this poor correlation: first physical distancing and hand washing were immediately advised, whereas only wearing face covering became mandatory. Additionally, there were structural missing items for people who did not leave their house during the assessment period for the physical distancing and face covering items, but not for handwashing, which could have led to low internal consistency. Nevertheless, the findings show strong predictive validity and could therefore still be useful in monitoring adherence to TRBs.

The final limitation is that we focused on Scotland, and it is unclear whether these results generalise to the rest of the world. However, studies on adherence to TRBs worldwide have shown similar results (Coroiu et al., 2020; Dixon et al., 2021; Park et al., 2020). Mostly, adherence was high initially, and some groups (i.e. the young, men) were less likely to adhere. While the exact restrictions (i.e. keeping 2 metres distance in Scotland versus 1.5 metres in the Netherlands), the timing and the communication differed between countries, we think we have captured the most important and generalisable behaviours and therefore think that this measure is applicable to many contexts.

Conclusion

The TRAM, a unidimensional measure we developed, is a useful measure for monitoring population-wide adherence to TRBs. The measure reflects a personal style of adherence. As long as not everybody is vaccinated, and vaccinations do not protect people for ever, TRBs remain crucial for the reduction of COVID-19 transmission. Moreover, as new infectious diseases emerge, alongside existing infections, such as the common cold, the TRBs will likely take up a permanent role in our society. We have offered a simple way to monitor behaviour, assess changes in behaviour and predict alternative TRBs when introduced.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

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References

Ajzenman, N., Cavalcanti, T., & Da Mata, D. (2020). More than words: Leaders' speech and risky behavior during a pandemic. *SSRN Electronic Journal. Available at SSRN 3582908*. https://doi.org/10.2139/ssrn.3582908

Bloomfield, S. F., Aiello, A. E., Cookson, B., O'Boyle, C., & Larson, E. L. (2007). The effectiveness of hand hygiene procedures in reducing the risks of infections in home and community settings including handwashing and alcohol-based hand sanitizers. *American Journal of Infection Control*, *35*(10), S27–S64. https://doi.org/10.1016/j.ajic.2007.07.001

Bourassa, K., Sbarra, D., Caspi, A., & Moffitt, T. (2020). Social distancing as a health behavior: County-level movement in the United States during the COVID-19 pandemic is associated with conventional health behaviors. *Annals of Behavioral Medicine*, *54*(8), 548–556. https://doi.org/10.1093/abm/kaaa049

CHARIS. (2020). *CHARIS: Covid health and adherence research in Scotland*. https://www.abdn.ac.uk/iahs/research/health-psychology/charis.php

Clark, C., Davila, A., Regis, M., & Kraus, S. (2020). Predictors of COVID-19 voluntary compliance behaviors: An international investigation. *Global Transitions*, *2*, 76–82. https://doi.org/10.1016/j.glt.2020.06.003

Coroiu, A., Moran, C., Campbell, T., Geller, A. C., & Capraro, V. (2020). Barriers and facilitators of adherence to social distancing recommendations during COVID-19 among a large international sample of adults. *PLoS One*, *15*(10), e0239795. https://doi.org/10.1371/journal.pone.0239795

den Daas, C., Hubbard, G., Johnston, M., & Dixon, D. (2020). Protocol of the COVID-19 health and adherence research in Scotland (CHARIS) study: Understanding changes in adherence to transmission-reducing behaviours, mental and general health, in weekly or fortnightly representative samples of the Scottish population. https://doi.org/10.31234/osf.io/jnxcu

Dixon, D., Den Daas, C., Hubbard, G., & Johnston, M. (2021). Using behavioural theory to understand adherence to behaviours that reduce transmission of COVID-19; evidence from the CHARIS representative national study. *British Journal of Health Psychology*, *27*(1), 116–135. https://doi.org/10.1111/bjhp.12533

Ersche, K. D., Lim, T. V., Ward, L. H. E., Robbins, T. W., & Stochl, J. (2017). Creature of habit: A self-report measure of habitual routines and automatic tendencies in everyday life. *Personality and Individual Differences*, *116*, 73–85. https://doi.org/10.1016/j.paid.2017.04.024

Greenhalgh, T., Schmid, M. B., Czypionka, T., Bassler, D., & Gruer, L. (2020). Face masks for the public during the covid-19 crisis. *BMJ*, *369*. https://doi.org/10.1136/bmj.m1435

Harper, C. A., Satchell, L. P., Fido, D., & Latzman, R. D. (2020). Functional fear predicts public health compliance in the COVID-19 pandemic. *International Journal of Mental Health and Addiction*. https://doi.org/10.1007/s11469-020-00281-5

Hu, L.-T., & Bentler, P. M. (1998). Fit indices in covariance structure modeling: Sensitivity to underparameterized model misspecification. *Psychological Methods*, *3*(4), 424. https://doi.org/10.1037/1082-989X.3.4.424

Jumaa, P. (2005). Hand hygiene: Simple and complex. *International Journal of Infectious Diseases*, *9*(1), 3–14. https://doi.org/10.1016/j.ijid.2004.05.005

Lauer, S. A., Grantz, K. H., Bi, Q., Jones, F. K., Zheng, Q., Meredith, H. R., Azman, A. S., Reich, N. G., & Lessler, J. (2020). The incubation period of coronavirus disease 2019 (COVID-19) from publicly reported confirmed cases: Estimation and application. *Annals of Internal Medicine*, *172*(9), 577–582. https://doi.org/10.7326/M20-0504

Lazzarino, A. I., Steptoe, A., Hamer, M., & Michie, S. (2020). Covid-19: Important potential side effects of wearing face masks that we should bear in mind. *The BMJ*, *369* doi:https://doi.org/10.1136/bmj.m2003.

Long, J. S. (1983). *Confirmatory factor analysis: A preface to LISREL* (Vol. 33). Sage Publications.

Nutt, K. (2020). *Covid in Scotland: Compliance with new lockdown rules 'good'. The National.* https://www.thenational.scot/news/18789273.covid-scotland-compliance-new-lockdown-rules-good/

Park, C. L., Russell, B. S., Fendrich, M., Finkelstein-Fox, L., Hutchison, M., & Becker, J. (2020). Americans' COVID-19 stress, coping, and adherence to CDC guidelines. *Journal of General Internal Medicine*, *35*(8), 2296–2303. https://doi.org/10.1007/s11606-020-05898-9

Plohl, N., & Musil, B. (2020). Modeling compliance with COVID-19 prevention guidelines: The critical role of trust in science. *Psychology, Health & Medicine*, 1–12 doi:https://doi.org/10.1080/13548506.2020.1772988.

Prem, K., Liu, Y., Russell, T. W., Kucharski, A. J., Eggo, R. M., Davies, N., . . . Munday, J. D. (2020). *The effect of control strategies to reduce social mixing on outcomes of the COVID-19 epidemic in Wuhan, China: A modelling study*. The Lancet Public Health.

Scottish Government. (2020). *Coronavirus (COVID-19): Scotland's route map*. (Accessed 08 20 2020). https://www.gov.scot/collections/coronavirus-covid-19-scotlands-route-map/

Scottish Government. (2021). *Coronavirus (COVID-19): Local protection levels*. (Accessed 05 02 2021). https://www.gov.scot/publications/coronavirus-covid-19-protection-levels/

Toussaint, L. L., Cheadle, A. D., Fox, J., & Williams, D. R. (2020). Clean and contain: Initial development of a measure of infection prevention behaviors during the COVID-19 pandemic. *Annals of Behavioral Medicine*, *54*(9), 619–625. https://doi.org/10.1093/abm/kaaa064

Warren-Gash, C., Fragaszy, E., & Hayward, A. C. (2013). Hand hygiene to reduce community transmission of influenza and acute respiratory tract infection: A systematic review. *Influenza and Other Respiratory Viruses*, *7*(5), 738–749. https://doi.org/10.1111/irv.12015