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Political stringency, infection rates, and higher education students' adherence to government measures in the Nordic countries and the UK during the first wave of the COVID-19 outbreak

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ABSTRACT

Understanding predictors of adherence to governmental measures to prevent the spread of the COVID-19 is fundamental to guide health communication. This study examined whether political stringency and infection rates during the first wave of the pandemic were associated with higher education students' adherence to COVID-19 government measures in the Nordic countries (Denmark, Finland, Norway, Iceland, and Sweden) and the United Kingdom.

Both individual- and country-level data were used in present study. An international cross-sectional subsample (n = 10,345) of higher-education students was conducted in May–June 2020 to collect individual-level information on socio-demographics, study information, living arrangements, health behaviors, stress, and COVID-19-related concerns, including adherence to government measures. Country-level data on political stringency from the Oxford COVID-19 Government Response Tracker and national infection rates were added to individual-level data. Multiple linear regression analyses stratified by country were conducted.

Around 66% of students reported adhering to government measures, with the highest adherence in the UK (73%) followed by Iceland (72%), Denmark (69%), Norway (67%), Finland (64%) and Sweden (49%). Main predictors for higher adherence were older age, being female and being worried about getting infected with COVID-19 (individual-level), an increase in number of days since lockdown, political stringency, and information about COVID-19 mortality rates (country-level). However, incidence rate was an inconsistent predictor, which may be explained by imperfect data quality during the onset of the pandemic.

We conclude that shorter lockdown periods and political stringency are associated with adherence to government measures among higher education students at the outset of the COVID-19 pandemic.

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1. Introduction

The COVID-19 pandemic, which the World Health Organization (WHO) declared a pandemic on March 11, 2020 (Cucinotta and Vanelli, 2020), presents a challenge to understanding and ensuring adequate public cooperation and adherence to government measures. Enhanced social control efforts stirred some conflicts, especially among the younger population, whose lives were particularly affected by the pandemic, despite the infection itself not having been as severe among this cohort (Williamson et al., 2020). Higher-education students across Europe were affected by congruent higher-education lockdowns, which facilitates cross-country comparisons that can be used to examine the impact of government measures.

Adherence to government COVID-19 restrictions is important to reduce the spread of the virus. In democratic societies, government measures like social distancing and self-quarantine cannot be enforced by coercion. Instead, the public must be persuaded of the importance of complying (Clark et al., 2020). Political stringency, sufficient information, and infection rates potentially hinder or facilitate students' adherence to government recommendations.

Political stringency is defined as the strictness of 'lockdown style' policies concerning workplaces, public events, gatherings, and stay-at-home requirements (Petherick et al., 2021). It is still debated whether political stringency supports (Chen et al., 2021) or hinders (Lee et al., 2021) population adherence. A study from US (Lee et al., 2021) showed that policy stringency was negatively associated with compliance with recommendations; however, a study using data from seven Asian countries showed that timeline and stringency of political measures supported adherence and helped to control the outbreak (Chen et al., 2021).

During the first wave of COVID-19, most countries developed fast and firm recommendations (Hanson et al., 2021; Berg-Beckhoff et al., 2021), which were considered the best option and were recommended by international public health organizations like the WHO, EC (2020). There are also consistent findings showing that trust in and being sufficiently informed by the government and relevant authorities are the most important predictors of adherence(Sadjadi et al., 2021; Pak et al., 2021; Gustavsson and Beckman, 2020, Seale et al., 2020; Al-Hasan et al. (2020b); Wright et al., 2020) and feeling sufficiently informed by them also support adherence to government measures (Gustavsson and Beckman, 2020). However, besides political stringency, less is known whether and how COVID-19 severity is associated with adherence. The severity of the pandemic can be measured by the compass or mortality rates. A longitudinal Swiss study demonstrated that regions with previously high COVID-19 incidence rates had stronger adherence to government recommendations than Switzerland's general population (Moser et al., 2021).

This study aims to examine whether political stringency and current incidence and mortality rates were associated with adherence to government COVID-19 measures among higher-education students in the Nordic countries (Denmark, Finland, Iceland, Norway, and Sweden) and the UK. In particular, we aimed to assess the importance of societal predictors of adherence, including both individual- and country-level variables, like political stringency, lockdown duration, and the number of cases and fatalities per day. We selected higher education students because we expected them to be more critical of restrictions. The countries were chosen due to the similar prerequisites for COVID-19 infection (e.g. temperature at time of the interview, socio-political history, and public health system) to exclude most other external factors that might bias the association.

2. Method

2.1. Student-level data

This study is part of the larger COVID-19 International Student Wellbeing Study that was collected in May 2020 (Van de Velde et al., 2021). Survey participation was voluntary and anonymous, and data were protected. The study adhered to European standards for ethical conduct of scientific studies and was approved by the independent ethic committee for Social Science and Humanities at the University of Antwerp (Case: SHW_20_38). More detailed information regarding the study protocol see (Van de Velde et al., 2021).

(Van de Velde et al., 2021). See country-specific information on data collection and variables used in Supplement A.

2.2. Country-level data

The Oxford Covid-19 Government Response Tracker *(OxCGRT)* was used to assess country-level political stringency index, days since lockdown, as well as the incidence and mortality rates. OxCGRT collects publicly available information on 20 indicators of government responses to COVID-19 (Hale et al., 2021). Policy stringency index records the strictness of 'lockdown style' policies that primarily restrict people's behavior. The score considers nine different indices about school and workplace closings, cancelation of public events, restrictions on public gatherings, public transport closures, stay-at-home requirements, restriction of international movements, international travel control, and public information campaigns (Petherick et al., 2021).

The weekly numbers of newly infected cases per 100.000 (incidence rate) and deaths per 100.000 (mortality rate), as well as number of days since lockdown were linked to the survey via the date when participants completed the questionnaire. A 7-day-incidence rate and 7-day-mortality rate were calculated by dividing theincidence or mortality rate by the population size per 100,000. Due to variation in daily numbers, the numbers from a week before were summed up.

Lockdown duration was measured as number of days since the commencing of government measures until the date when the students completed the questionnaire. Lockdowns in educational setting happened between 13-18th March.

2.3. Statistical analysis

After combining the data, the political stringency score for the respective countries varied from 39.8 (Iceland) to 79.6 (the UK), and tertiles with the cut-off points 58 and 65 were created. The COVID-19 7-day incidence varied from 0.6 (Norway) to 75.4 (UK), and the COVID-19 7-day mortality varied from 0 (Iceland) to 5.6 (UK). Duration of lockdown varied from 44 to 123 days, so tertiles were created with the cut-off points of 64 days and 83 days.

A multiple linear regression model of country-level data (political stringency, lockdown duration, incidence and mortality rates) predicting individual-level data (self-reported adherence to governmental COVID-19 measures) encompassing all countries was conducted. Beta coefficients present positive or negative relations, and the effects were significant if the 95% CI excluded zero. Socio-demographics (gender, age, living situation, income and education) and psychological -related predictors (academic stress, depressive symptoms, loneliness? COVID-19 related concerns), were used as confounders. Model assumptions were considered graphically. To ensure a normal distribution of residuals, it was necessary to square transform the outcome. After transformation, residual and normal plots showed that normality, linearity, and homogeneity assumptions held. Academic stress and depressive symptoms were considered numerically, with an additional square transformed variable, to ensure linear association with the outcome. The transformation was not necessary for loneliness. We tested for interaction between country-level variables (days since lockdown, 7-day incidence, 7-day mortality, and political stringency), gender, and each country. The interaction for gender (only female, male) was not significant for any outcome, and the interaction between country and lockdown duration was insignificant. Interaction terms between country and 7-day incidence ($p < 0.0001$), 7-day mortality ($p = 0.003$) and political

stringency ($p = 0.009$) were significant. Therefore, only country-stratified results from the overall multiple models are presented (Table 4). Statistical analysis was conducted in STATA 9.4. Finally, collinearity was tested in all models. Excluding squared and interaction terms, all variables revealed a variance inflation factor far below 5.

3. Results

Overall, 10,345 students completed the questionnaire. Socio-demographic distribution by country are presented in Table 1. Most participants were female (73.4%), 25 years old or younger (43.2%), and bachelor's students (55.7%).

The percentage of students following government measures was high (Table 2). In total, 66% said they strictly followed governmental measures (lowest Sweden 48.8%; highest UK 73.0%). Adherence in countries varied significantly ($p < 0.001$). Around half (46.1%) were worried about getting infected by COVID-19 (highest UK: 66.3%; lowest Denmark: 18.0%). High agreement of feeling informed was seen in Iceland (84.9%), and lowest in UK (23.4%). The prevalence of depression and loneliness was similar across the countries, with an overall mean of 10.45 (standard deviation (SD) = 2.88) for the CES-D depression score and a mean of 2.91 (SD = 2.43) for the loneliness score. Only small differences in academic stress were observed across countries.

Fig. 1a, b, and c present time-relevant information about 7-day COVID-19 incidence, mortality, and governmental stringency for all six countries. Based on incidence data, Iceland had high incidence numbers at the beginning of the pandemic (March–April 2020), and Sweden had a later peak in June 2020, which is not relevant for the present analysis (Fig. 1a). However, based on mortality rates, Denmark and Sweden had a peak in April–May 2020, even though a similar early-increase in incident rate was missing (Fig. 1b). There were small country-related differences in political stringency; however, stringency scores increased alongside a growing number of cases in all countries and decreased slowly after the first peak. The UK's COVID-19 lockdown policy was the strictest and Iceland's the least strict. Norway's policy was strict during the first wave but was soon eased.

Table 3 presents country-level data on political stringency, incidence and mortality rates. Seven-day incidence was highest in Sweden with 86.6% with a 7-day incidence above 50 (mean = 69.27, SD = 12.33). The lowest 7-day incidence was reported in Norway, with 73.4% with a 7-day incidence below two mean = 1.86, SD = 0.25). Additionally, the

Table 1
Description of the study population, overall and by Denmark, Finland, Iceland, Norway, Sweden and UK based on the student-specific data.

	Overall		Denmark		Finland		Iceland		Norway		Sweden		UK	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Overall n	10345	100.0	2281	100.0	1064	100.0	491	100.0	3210	100.0	1274	100.0	2025	100.0
Gender														
Men	2682	25.9	480	21.0	217	20.4	99	20.2	1019	31.1	434	34.1	433	21.4
Women	7590	73.4	1786	78.3	832	78.8	387	67.8	2176	67.8	832	65.3	1577	77.9
Other	73	0.7	15	0.7	15	1.4	5	1.0	15	0.5	8	0.6	15	0.7
Age														
≤ 21	2330	22.5	263	11.5	199	18.7	63	12.8	600	18.7	286	22.5	919	45.4
22–24	3068	20.7	857	37.6	329	30.9	95	19.4	1010	31.5	353	27.7	424	20.9
25–30	2796	27.0	851	37.3	283	26.6	150	30.6	839	26.1	375	29.4	298	14.7
> 30	2151	20.8	310	13.6	253	23.8	183	37.3	761	23.7	260	20.4	384	19.0
Relationship														
Single	4682	45.3	791	34.7	413	38.8	170	34.6	1801	56.1	587	46.1	920	45.4
Not single	5663	54.7	1490	65.3	651	61.2	321	65.4	1509	43.9	687	53.9	1105	54.7
Study program														
Bachelor's student	5757	55.7	1064	46.7	726	68.2	291	59.3	1724	53.7	520	41.4	1424	70.3
Master's student	3372	32.6	1026	45.0	318	30.0	162	33.0	1073	33.4	423	33.2	370	18.3
PhD student	493	4.8	160	7.0	15	1.4	29	5.9	132	4.1	90	7.1	67	3.3
Other or unknown	723	7.0	31	1.4	5	0.5	9	1.8	281	8.8	233	18.3	164	8.1
Study field														
Education	1302	12.6	12	0.5	66	6.2	57	11.6	771	24.0	85	6.7	311	15.4
Humanities and arts	1077	10.4	177	7.8	247	23.2	56	11.4	130	4.1	143	11.2	324	16.0
Social science	2078	20.1	344	15.1	225	21.2	149	30.4	369	14.6	346	27.2	545	26.9
Science	973	9.4	117	5.1	105	9.9	61	12.4	332	10.3	251	19.7	107	5.3
Engineering	935	9.0	6	0.3	103	9.7	26	5.3	537	16.7	130	10.2	133	6.6
Health	3586	34.7	1489	65.3	255	24.0	116	23.7	936	29.2	271	21.3	519	25.6
Other	394	3.8	136	6.0	63	5.9	26	5.3	35	1.1	48	3.8	86	4.3
Living situation														
With parents	1486	14.4	130	5.7	45	4.2	128	26.1	332	10.3	99	7.8	752	37.1
Student hall	1826	17.7	315	13.8	68	6.4	68	13.9	618	19.3	410	32.2	347	17.1
With others	3480	33.6	1313	57.6	342	32.1	69	14.1	1113	34.7	212	16.6	431	21.3
Alone	1640	15.9	449	19.7	413	38.8	37	7.5	247	7.7	287	22.5	207	10.2
Other	1913	18.5	74	3.2	196	18.4	189	38.5	900	28.0	266	20.9	288	14.2
Parental education level														
Low	679	6.6	133	5.8	52	4.9	60	12.2	201	6.3	56	4.4	177	8.7
Medium	2410	23.3	245	10.7	388	36.5	137	27.9	627	19.5	251	19.7	762	37.6
High	7256	70.1	1903	83.4	624	58.6	294	59.9	2382	74.2	967	75.9	1086	53.6

Table 2
Description of COVID-19 related information and mental health, overall and by Denmark, Finland, Iceland, Norway, Sweden and UK based on the student-specific data.

	Overall		Denmark		Finland		Iceland		Norway		Sweden		UK	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Overall n	10345	100.0	2281	100.0	1064	100.0	491	100.0	3210	100.0	1274	100.0	2025	100.0
Adherence to governmental recommendations														
Low	410	4.0	61	2.7	29	2.7	14	2.9	67	2.1	98	7.7	141	7.0
Medium	3090	29.9	660	28.9	351	33.0	125	25.5	994	30.1	554	43.5	406	20.0
Strong	6844	66.1	1560	68.9	684	64.3	352	71.7	2148	66.9	622	48.8	1478	73.0
Concern about infection														
Not at all	5381	52.0	1493	65.5	472	44.4	245	49.9	1898	59.1	642	50.4	631	31.2
Medium	3391	32.8	596	26.1	412	38.7	171	34.8	1012	31.5	426	33.4	774	38.2
High	1375	13.3	134	5.9	165	15.5	66	13.4	276	8.6	165	13.0	569	28.1
Already infected	198	1.9	58	2.5	15	1.4	9	1.8	24	0.75	41	3.2	51	2.5
Feeling informed by the government on time														
Agree	6082	58.8	1870	82.0	758	71.2	417	84.9	2017	62.8	546	42.9	474	23.4
Neither/nor	1599	15.5	232	10.2	146	13.7	55	11.2	594	18.5	289	22.7	283	14.0
Disagree	2664	25.7	179	7.8	160	15.0	19	3.9	599	18.7	439	34.4	1268	62.6
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Mental health														
Depression	10.49	2.88	10.32	2.70	10.72	2.93	9.38	2.57	10.10	2.78	10.25	2.84	11.57	2.96
Academic stress	8.48	3.81	8.29	3.69	7.68	3.84	8.32	3.97	8.39	3.82	7.70	3.78	9.80	3.56
Loneliness	2.91	2.43	2.85	2.26	2.95	2.49	2.32	2.14	2.49	2.24	2.92	2.40	3.72	2.68

7-day mortality was only above one in UK and Sweden. The strictest political interventions were implemented in the UK (mean = 74.4, SD = 3.4) and Denmark (mean = 65.4, SD = 4.0) followed by Sweden (mean = 60.1, SD =1.9), Finland (mean = 56.3, SD = 3.2), Norway (mean = 50.1, SD = 7.5), and Iceland (mean = 39.8. SD = 0.0), respectively.

Congruent multiple linear regression (Table 4), results across countries were as follows: (1) lockdown duration was negatively associated with adherence, (2) political stringency was positively associated with adherence, (3) the 7-day mortality a week before students completed the questionnaire was positively associated with adherence, (4) all associations between adherence and 7-day incidence, mortality, and political stringency became insignificant when lockdown duration was added to models, except for a small estimate for 7-day incidence a week before in Iceland.

There were considerable cross-country differences regarding the association between adherence and 7-day incidence. In countries with low incidence (Norway and Iceland) a higher incidence was associated with decreased adherence. In contrast, in countries with higher incidence (Denmark, Finland, and the UK, a higher 7-day incidence, was associated with stronger adherence. Furthermore, everywhere except Denmark, 7-day mortality at the day of the survey had weaker association with adherence than 7-day mortality a week before. Theses differences are supported by a correlation matrix between all exposure and the outcome (Supplementary Table B).

The 7-day mortality and political stringency were constant during the survey period in Iceland (7-day mortality was 0 and political stringency index was 38 throughout), and the 7-day mortality in Norway was 0.04 with very small variation. Thus, both countries were dropped from the model and the correlation analysis. An overall summary of results is presented in Table 5.

4. Discussion

The present study examined whether political stringency and COVID-19 incidence and mortality rates were associated with higher-education students' adherence to government measures in the Nordic countries and the UK. Specific attention was paid to societal factors, including country-level policy indicators about closure stringency, lockdown duration, the number of cases and fatalities per day.

We found that a high percentage (66%) of students reported that they strongly followed government measures. When looking at political stringency and infection rates at the time of the survey, the best predictor of adherence was lockdown duration. This result gives additional support to WHO's recommendations to keep necessary lockdown periods as short as possible as this not only decreases the negative impact on individuals, communities, and societies (WHO, 2020b, 2020c), but might also be associated with stronger adherence. Adherence to governmental measures was strongest at the beginning of the lockdown period and decreased steadily over time.

A positive correlation between political stringency and adherence across the countries was detected, even though COVID-19 measures varied. These results are inconsistent with Lee et al. (2021) study, where they reported a negative association between stringency and adherence to mask-wearing and social distancing. However, the authors acknowledged that their data had substantial variability and that their measure of perceived policy stringency was influenced by objective risk and political ideology (Lee et al., 2021). Also, the US study was based on perceived political stringency, which might be confounded by political ideology, whereas our results were based on objective stringency scores (Hale et al., 2021). Furthermore, our study did not examine mask-wearing or social distancing but self-reported adherence to government measures. On the other hand, our study supports the findings from Asian countries regarding the importance of stringent political activities to control the outbreak (Chen et al., 2021). Finally, a cross-country comparison between the US, Kuwait, and South Korea showed that perception of government response efforts was positively associated with recommended adherence to regulations (Al-Hasan et al. (2020a)). This association was most pronounced for South Korea and less so for Kuwait and the US. Al Hasan and colleagues argued that in South Korea, the population is more willing to follow government guidelines during national crises, whereas in US and Kuwait, the public valued social freedom, and may have lacked information towards government measures. Further research is warranted, to focus on the effect of social values but also the political orientation of the government.

When the variable lockdown duration was included in the model, the association between political stringency and adherence was no longer

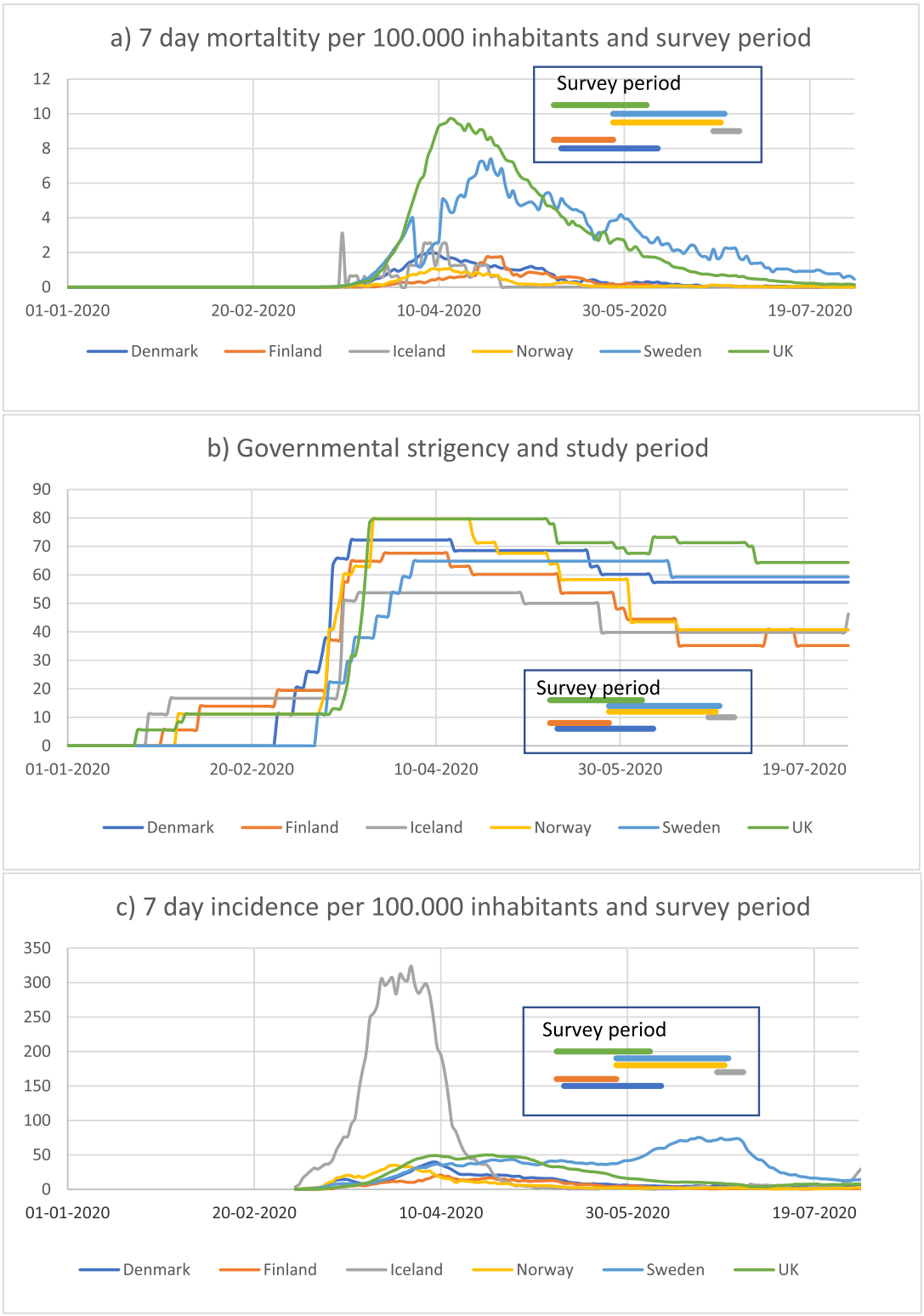

Fig. 1. Timeline of 7-day incidence per 100.000 inhabitants (1a) 7-day mortality per 100.000 inhabitants (1b) and political stringency (1c) during the first wave of COVID 19- infection, based on Oxford COVID-19 Governmental Response Tracker for Denmark, Finland, Iceland, Norway, Sweden, and UK in 2020.

significant (Table 4). This was expected since an increase in number of days since lockdown was strongly correlated with political stringency in most countries, except Sweden. Both variables essentially measured the same phenomenon. Strict measures make sense when infection rates are alarming, and recommendations can be eased when an infection wave is over.

Students in Sweden had the lowest willingness to adhere to government measures even though the strength of the association between political stringency and adherence was similar to other countries. Also, political stringency did not vary between countries, even though we expected differences – particularly in Sweden due to widespread media coverage of their less strict government measures to prevent the spread

Table 3
Description of COVID-19 related infection and political stringency scoring related to the date when questionnaire was filled in Denmark, Finland, Iceland, Norway, Sweden and UK in the year 2020.

	Overall*		Denmark		Finland		Iceland		Norway		Sweden		UK	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Overall n	10345	100.0	2281	100.0	1064	100.0	491	100.0	3210	100.0	1274	100.0	2025	100.0
Lockdown duration														
1st tertile**	3657	35.4	1035	45.4	718	67.5	0	0.0	0	0.0	0	0.0	1904	94.0
2nd tertile**	3434	33.2	1190	52.2	346	32.5	0	0.0	1595	49.7	182	14.3	121	6.0
3rd tertile**	3254	31.5	56	2.5	0	0.0	491	100.0	1615	50.3	1092	85.7	0	0.0
7-day-incidence #														
7-day incidence >50	1103	10.6	0	0.0	0	0.0	0	0.0	0	0.0	1103	86.6	0	0.0
7-day incidence 30–50	1304	12.6	0	0.0	0	0.0	0	0.0	0	0.0	272	13.4	1133	56.0
7-day incidence 5–30	4335	41.9	2272	99.6	991	93.1	180	36.7	0	0.0	0	0.0	892	44.0
7-day incidence 2–5	987	9.5	9	0.4	73	6.9	50	10.2	855	26.6	0	0.0	0	0.0
7-day incidence >2	2616	25.3	0	0.0	0	0.0	261	53.2	2355	73.4	0	0.0	0	0.0
7-day-mortality #														
7-day-mortality <1	7046	68.11	2281	100.0	1064	100.0	491	100.0	3210	100.0	0	0.0	0	0.0
7-day mortality >1	3299	31.89	0	0.0	0	0.0	0	0.0	0	0.0	1274	100.0	2025	100.0
Political stringency														
1st tertile**	4323	41.8	0	0.0	662	58.5	491	100.0	3210	100.0	0	0.0	0	0.0
2nd tertile**	2585	25.0	869	38.1	442	41.5	0	0.0	0	0.0	1274	100.0	0	0.0
3rd tertile**	3437	33.2	1412	61.9	0	0.0	0	0.0	0	0.0	0	0.0	2025	100.0

* Results are presented overall and for each country separately based on Oxford COVID-19 Governmental Response Tracker.
** Tertiles separate numerical variable into a categorical variable using the distribution of the underlying variable.
# Seven-day incidence and seven-day mortality sums up the incidence and mortality numbers of the last seven days divided by the number of the underlying population.

of COVID-19 (Pickett, 2021). Due to the cross-sectional nature of the data, we cannot rule out specific explanations for the low willingness to comply with recommendations in Sweden. It is possible that the measure of stringency did not capture all the nuances of different national contexts and the ways recommendations were made.

Our analysis yielded inconsistent results regarding the association between incidence rates and adherence across the countries (see Table 5). One potential explanation is that, the incidence rates were not sufficiently measured and recorded to present an accurate picture of the severity of the pandemic in the population, particularly at the beginning of the pandemic. Therefore, information about the 7-day mortality rate was a better predictor of students' adherence in all participating countries. To our knowledge, the only other study investigating the relation between incidence rate and adherence is from Switzerland, indicating that adherence is higher in regions with previously higher incidence (Moser et al., 2021). Our findings support this result. However, our findings demonstrate that there was no clear linear association between the incidence rate and adherence. The association may also have depended on country-specific situations, e.g., quality of incidence data and form of data collection, media campaign or the overall duration of the 'wave' and therefore further research is warranted.

Mortality rates predicted adherence better than incidence rates (Table 4). Our data do not allow us to disentangle whether adherence is better predicted by 7-day mortality rates on the day of data collection or a week before. However, the Swiss study from Moser et al., 2021 showed that higher incidence rates in an area were associated with better adherence at a later date. Further research is necessary to clarify the association between the overall trend in mortality rates and adherence, as differences in communication and knowledge between the countries are to be expected. Particularly for health communication, it would be worthwhile to shed more light on the association between the actual incidence and mortality rates and adequate information regarding the spread of the virus, and how this predicts adherence to government measures.

Overall, predictors of adherence to government measures are difficult to identify. Our model only explains 10% of the variation in adherence, which is consistent with other studies reported by Margraf et al. (2020) (9%) and Al-Hasan et al. (2020b) (18%). The most consistent predictors of strong adherence in all six countries were being a woman and older age (data not shown). Lockdown duration, political stringency, 7-day incidence, and mortality rates only explain a small part (5% or less) of the variation in governmental adherence. Furthermore, worries about getting infected by the virus were associated with stronger adherence, whilst experiencing depressive symptoms or academic stress were associated with weaker adherence. These results are consistent with most studies (Hills and Eraso, 2021; Muto et al., 2020a, 2020b; Al-Hasan et al., 2020a, 2020b; Coroiu et al., 2020; Margraf et al., 2020).

The study's main limitation is the cross-sectional design, that does not allow to investigate causal relations. Therefore, it is unlear, whether stringent policy leads to a more compliant population behavior, or whether stringent policy is implemented only when the government believes the population will comply. Furthermore, the results are limited by the small variation in the stringency data and the fact that we only considered the first wave of COVID-19. Another limitation is low response rates, which differ between countries (10–18%) and may cause response rate bias. However, these response rates are common in online surveys (Couper, 2007). An additional sensitivity analysis, considering early response as a confounder showed that the association between lockdown duration and adherence was even stronger. Women are overrepresented in this survey compared with women in tertiary education in the corresponding countries (EUROSTAT, 2020; Supplementary Table A). One of the main reason is a higher number of participants were from humanity and health science studies, which attract more female students. Additionally, women tend to participate more in surveys than men (Hermans et al., 2022). However, we believe, that overrepresentation of women does not distort the results as gender stratified analysis revealed similar results; no interaction was present.

The strengths of this study are that the analysis is based on a very large sample, which can provide more accurate mean values and a

Table 4
Results from multiple linear regression models containing interactions between the different exposures with student's adherence to COVID-19 measures implemented in Denmark, Finland, Iceland, Norway, Sweden, and UK (bold numbers are significant).

	Denmark		Finland		Iceland		Norway		Sweden		UK	
	Beta	95% CI	Beta	95% CI	Beta	95% CI	Beta	95% CI	Beta	95% CI	Beta	95% CI
Lockdown duration *(LD)*[*]												
Single model[*]	**−0.22**	**−0.35; −0.09**	**−0.55**	**−0.91; −0.18**	**−0.32**	**−0.61; −0.03**	**−0.19**	**−0.33; −0.04**	−0.13	−0.30; 0.04	**−0.33**	**−0.51;-0.15**
Adjusted model[#]	**−0.20**	**−0.33; −0.75**	**−0.50**	**−0.86; −0.14**	**−0.42**	**−0.70; −0.13**	**−0.22**	**−0.36; −0.08**	−0.13	−0.30; 0.03	**−0.29**	**−0.47;-0.11**
7-day incidence At the day of the survey												
Single model[*]	**0.36**	**0.09; 0.63**	**1.13**	**0.43; 1.84**	−0.23	−1.60; 1.14	−0.37	−3.87; 3.13	−0.07	−0.18; 0.04	**0.35**	**0.16; 0.55**
Adjusted model[#]	**0.35**	**0.07;0.62**	**1.03**	**0.35; 1.73**	−0.57	−1.92; 0.77	−0.81	−4.26; 2.62	−0.07	−0.18; 0.04	**0.31**	**0.11; 0.51**
Additional adjusted for LD[&]	−0.20	−0.56; 0.15	0.54	−0.18; 1.26	−0.20	−1.54; 1.15	−0.07	−3.53; 3–37	0.09	−0.04; 0.22	0.02	−0.20; 0.25
7-day incidence A week before												
Single model[*]	**0.39**	**0.14; 0.63**	0.60	−0.33; 1.54	−2.43	−3.97; 0.90	**2.47**	**0.92; 5.86**	−0.11	−0.24; 0.02	**0.31**	**0.14; 0.47**
Adjusted model[#]	**0.36**	**0.11;0.60**	0.61	−0.31; 1.52	**−2.75**	**−4.26; −1.25**	2.99	−0.32; 6.32	−0.12	−0.24; 0.01	**0.27**	**0.11; 0.41**
Additional adjusted for LD[&]	−0.11	−0.49; 0.27	0.10	−0.87; 1.07	**−1.77**	**−3.40; −0.15**	−0.82	−4.92; 3.28	0.06	−0.11; 0.22	0.05	−0.16; 0.29
7-day mortality[$] At the day of the survey												
Single model[*]	**0.74**	**0.24; 1.25**	0.98	−0.28; 2.25	–		**–**		0.19	−0.04; 0.42	**0.28**	**0.14; 0.42**
Adjusted model[#]	**0.73**	**0.23; 1.23**	1.04	−0.20; 2.28					0.21	−0.01; 0.44	**0.25**	**0.11; 0.38**
Additional adjusted for LD[&]	0.16	−0.51; 0.84	0.54	−0.76; 1.85					0.01	−0.29; 0.28	0.12	−0.05; 0.29
7-day mortality[$] A week before												
Single model[*]	**0.34**	**0.07; 0.62**	**1.57**	**0.37; 2.78**	–		–		**0.32**	**0.06; 0.67**	**0.20**	**0.10; 0.30**
Adjusted model[#]	**0.31**	**0.05; 0.58**	**1.34**	**0.16; 2.52**					**0.33**	**0.08; 0.58**	**0.17**	**0.08; 0.27**
Additional adjusted for LD[&]	−0.20	−0.59; 0.18	0.53	−0.72; 1.79					−0.03	−0.34; 0.29	0.04	−0.08;0.15
Political stringency												
Single model[*]	**0.42**	**0.25; 0.68**	**0.67**	**0.19; 1.15**	–		**0.15**	**0.03; 0.27**	0.59	−0.12; 1.29	**0.63**	**0.30; 0.51**
Adjusted model[#]	**0.40**	**0.14; 0.66**	**0.55**	**0.08; 1.02**			**0.17**	**0.05; 0.29**	0.59	−0.10; 1.29	**0.57**	**0.25; 0.89**
Additional adjusted for LD[&]	−0.00	−0.37; 0.37	0.35	−0.14; 0.83			0.01	−0.14; 0.83	−0.25	−1.14; 0.64	0.27	−0.11; 0.64

[*] All single models are adjusted for age and sex.
[#] All adjusted models are further adjusted for being single, education of parents, study field, study program, living situation, depression, academic stress, loneliness, being worried about infection, feeling informed from the government on time.
[&] Adjusted for all variables mentioned before and additional adjusted for lockdown duration (LD).
[$] Seven-day mortality is multiplied with 10 to facilitate interpretation. The estimate can therefore be interpreted as an 0.1 increase in mortality. This was done as most mortality numbers in the survey were below 1 per 7 day.

smaller margin of error. Furthermore, the timing of data collection was ideal. Our survey was implemented during the first re-opening phase, when public support for COVID-19 measures started to erode.

5. Conclusion

This cross-sectional study on higher education students' adherence to COVID-19 government measures in the Nordic countries and the UK showed that political stringency, lockdown duration, and 7-day mortality rate were important and consistent predictors of adherence to COVID-19 measures implemented by governments. Denmark, Finland and UK are countries with stringent patterns, where high incidence-, mortality-rates and political stringency was associated with increased adherence to governmental measures. The 7-day incidence rate did not predict adherence in countries where the incidence rate was low, like Iceland and Norway. However, results in Sweden were inconclusive. It can be concluded that shorter lockdowns and high political stringency increased adherence to COVID-19 measures implemented by governments during the first wave of the pandemic in May 2020.

Table 5
Summary of findings.

	Denmark	Finland	UK	Iceland	Norway	Sweden	Summary
Lockdown duration	-!	-!	-!	-!	-!	-!	Negative association
7- day incidence At the day of the survey	+!	+!	+!	−	−	−	Mixed results
7-day incidence A week before	+!	+	+!	-!	+	−	Mixed results
7- day mortality At the day of the survey	+!	+	+!	ne	ne	+	Positive association
7-day mortality A week before	+!	+!	+!	ne	ne	+!	Positive association
Political stringency	+!	+!	+!	ne	+!	+!	Positive association
	Denmark, Finland and UK are countries with stringent patterns, where high incidence and mortality and stringency is associated with high following governmental measures			Iceland and Norway are countries with low incidence and mortality where associations are unclear		Unclear asso-ciations	

+: positive association, −: negative association,!: significant association, ne: not estimated.

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Data availability statement

Due to the nature of this research, participants of this study did not agree for their data to be shared publicly, so supporting data are not publicly available. Data are available on request from the corresponding author for collaborating researchers within the C19ISWS-consortium, as consent for this was provided from all participants.

Authors' contributions

Berg-Beckhoff, Bask, Jervelund, Guldager and Van de Velde jointly conceptualized the present project and Beckhoff drafted the manuscript and carried out the statistical analysis with support from Buffel, van der Wel and Sarasjärvi. All authors were involved in the designing, leading, and conducting country-specific surveys in Denmark (Berg-Beckhoff, Jervelund, Guldager), Finland (Sarasjärvi), Iceland (Oddsson, Olafsdottir), Norway (van der Wel, Skalická), Sweden (Bask), and the UK (Quickfall, Rabiee Khan). Van de Velde is the overall coordinator, and Buffel the data manager for the COVID-19 International Student Well-being Study. For discussion purposes, the overall and country-specific contributions of all authors allowed result interpretation. All authors reviewed, edited, and approved the manuscript.

CRediT authorship contribution statement

G. Berg-Beckhoff: Conceptualization, Formal analysis, Data curation, Writing – original draft. **M. Bask:** Conceptualization, Data curation, Writing – review & editing. **S.S. Jervelund:** Conceptualization, Data curation, Writing – review & editing. **J.D. Guldager:** Conceptualization, Data curation, Writing – review & editing. **A. Quickfall:** Data curation, Writing – review & editing. **F. Rabiee Khan:** Data curation, Writing – review & editing. **G. Oddsson:** Data curation, Writing – review & editing. **K.A. van der Wel:** Data curation, Writing – review & editing. **K.K. Sarasjärvi:** Formal analysis, Data curation, Writing – review & editing. **S. Olafsdottir:** Data curation, Writing – review & editing. **V. Buffel:** Methodology, Formal analysis, Writing – review & editing. **V. Skalická:** Data curation, Writing – review & editing. **S. Van de Velde:** Project administration, Formal analysis, Conceptualization, Data curation, Writing – review & editing.

Declaration of Competing Interest

We wish to confirm that there are no known conflicts of interest associated with this publication. All authors have read and approved the final manuscript and the article has not been published and is not under consideration for publication elsewhere. We further confirm that the order of authors listed in the manuscript has been approved by all authors.

Data availability

The authors are unable or have chosen not to specify which data has been used.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ypmed.2022.107245.

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