Title: Social disparities in adopting non-pharmaceutical interventions during COVID-19

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Abstract:

Background: In the absence of antiviral medications and vaccines to fight the emerging COVID-19 pandemic, in 2020 governments had to respond by relying on non-pharmaceutical interventions (NPIs) to control the disease burden. Socioeconomic inequalities likely influenced the ability or willingness of individuals to adopt these measures in both private and work contexts.

Data & Methods: Using survey data from a representative sample of the Norwegian working population, we study to what extent socioeconomic status as measured by income was a significant predictor of more handwashing, keeping 1m distance from others, using protective equipment such as masks, more use of home office, and less use of public transportation in a private and work context during the spread of the COVID-19 pandemic in the winter and spring of 2020.

Results: With the exception of using protective equipment and using less public transportation in a private context, all analyzed NPIs showed a clear and independent positive association with income controlling for age, sex, region and education.

Conclusion: Social disparities in adopting central public health measures suggested by governments may be important drivers for higher risks of infection, hospitalization and mortality for people of lower socioeconomic status, as documented in Norway and several countries during the COVID-19 pandemic.

Introduction:

During the spread of the COVID-19 pandemic in 2020, no vaccines or antiviral medicines were available. Governments, health politicians, national institutes of public health and other stakeholders therefore relied on the use of non-pharmaceutical interventions (NPIs) to reduce the spread of the disease. Whether and to what extent people changed behavior and followed public health advice of, for example, washing their hands more often, increasing their distance from others, working more from home and using less public transportation was therefore fundamental for reducing infections, hospitalizations and mortality.

Several studies on European countries and the US reported substantial social, ethnic and racial disparities in COVID-19 pandemic outcomes (Batty et al., 2020; Dahal, Mizumoto, Rothenberg, & Chowell, 2020; Holmes et al., 2020; Sood & Sood, 2020). A study analyzing all COVID-19 related deaths in Sweden found there were independently higher risks for those with lower disposable incomes and lower education levels, as well as those who were immigrants from a low- or middle income country (Drefahl et al., 2020). Analyses of in-hospital mortality in the UK showed that deprivation and people from Asian and Black populations had higher risks, with little of the excess risks for these groups explained respectively by co-morbidities or deprivation (Williamson et al., 2020). Most studies on deprivation, ethnic and social inequalities have not had data to identify the drivers of these associations.

One reason for social disparities in COVID-19 pandemic outcomes in 2020 may have been social disparities in compliance with NPIs. In this paper, we use survey data from a representative sample of Norwegian workers to investigate socioeconomic differences in self-reported NPI use during the diffusion of COVID-19 in the winter and spring of 2020 in Norway, which enforced an early and encompassing lockdown. To our knowledge, this is the first study on this issue for a Scandinavian welfare state which, along with Denmark and Finland, succeeded in keeping morbidity and mortality at a very low level and with little to no excess all-cause mortality due to COVID-19, at least during the first phases of the pandemic (Vestergaard et al., 2020). The success in these countries may be due to strict lockdowns. Sweden, the last of the four Scandinavian welfare states, introduced a less strict lockdown and had one of the highest pandemic mortality tolls per capita internationally. This comparison shows that even a high income welfare state can experience high mortality in a situation without vaccines, strict lockdowns and high compliance with NPIs.

Results from a survey on NPI use in a high-income country with early and strict lockdown such as Norway may bear important implications and insights for low-income countries which may not be able to afford vaccines for all and for settings which did not gather survey data on the course of the

pandemic and the role of NPIs on the disease burden in 2020. Increased knowledge about these measures could prevent severe pandemic outcomes in the next waves of COVID-19 in 2021 and beyond or other future pandemics.

Diffusion of COVID-19 in Norway in the spring and winter of 2020

Norway is a small, open, high-income welfare state economy with a population of 5.4 million people. The country is located in northern Europe on the western part of the Scandinavian Peninsula. Norway is surrounded by the North Sea and Atlantic Ocean on the west side, and borders Russia, Finland, and Sweden to the east. The first lab-confirmed case of COVID-19 in Norway was recorded on 21 February 2020 (Figure 1). The Norwegian government implemented a "lockdown" on 12 March. The lockdown measures included 1) testing, isolation of the sick, contact tracing and quarantine of the exposed; 2) advice on good hand and coughing hygiene, social distancing (1 meter distance), using less public transportation, and working more from home; 3) closing of the national border and of kindergartens, schools, cinemas, theatres, libraries and hair salons; 4) bans of sports events, and later also travel to second homes. Mask use was not recommended in Norway at that time, and even during the height of the first pandemic wave in the winter and spring of 2020, few wore masks in the public, including on public transportation.

In the initial period of the pandemic until mid-2020, the spread of COVID-19 peaked at the end of March 2020, not only in terms of lab-confirmed cases, but also in terms of hospitalizations, patients treated in intensive care units and deaths. There were fewer new daily lab-confirmed cases at the end of April when the government started a gradual and slow opening of the lockdown. On 20 April, the government reopened kindergartens, physiotherapists and psychologist practices, and the ban on going to second homes was lifted as well. A week later, on 27 April, the government reopened primary schools (1-4th grade) and parts of high schools and universities and hair salons. Scattered cases were reported throughout May and June. As of 3 July 2020, 348,208 had been tested, 8,895 tested positive, 946 had been hospitalized, 225 had been treated in intensive care units and 251 had died.[1] Figure 1 shows the lab-confirmed COVID-19 cases in Norway in the period during which our survey was carried out. With a still ongoing pandemic at the time of writing this paper, these numbers and other disease burden statistics cover only the first and not later waves and are thus not final.

[1] https://www.fhi.no/sv/smittsomme-sykdommer/corona/dags--og-ukerapporter/dags--og-ukerapporter-om-koronavirus/

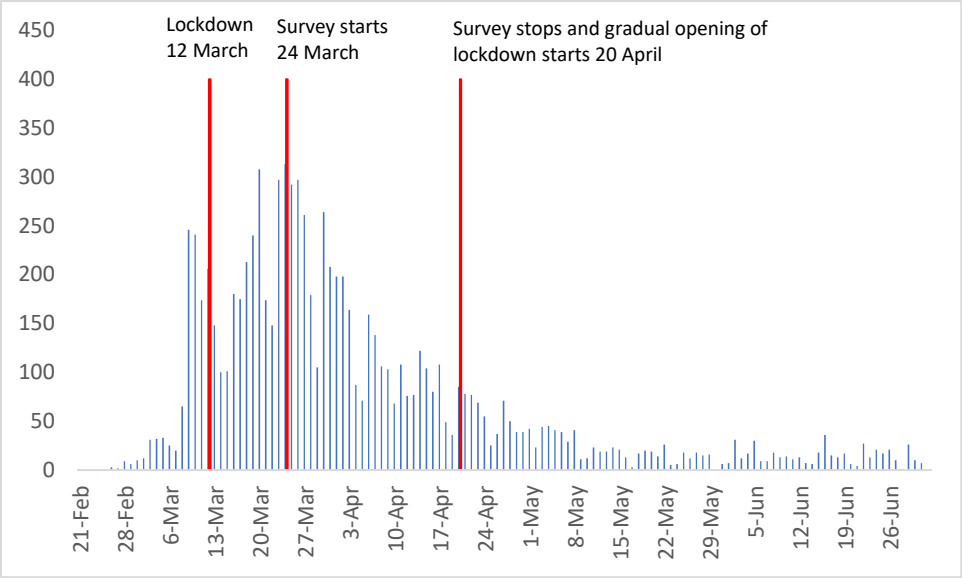

Figure 1. Number of lab-confirmed COVID-19 cases in Norway by date of testing 21 February-3 July 2020

Source: https://www.fhi.no/sv/smittsomme-sykdommer/corona/dags--og-ukerapporter/dags--og-ukerapporter-om-koronavirus/

Prior literature on socioeconomic factors and NPI compliance:

Some have argued that socioeconomic status is not important for NPI compliance, and that personality traits, emotionality, intentions and attitudes towards the guidelines play a much more important role (Bogg & Milad, 2020; Raude, 2020; Zettler, Schild, Lilleholt, & Böhm, 2020). However, there is a fast-growing body of research investigating compliance with the mitigation interventions under COVID-19 showing the importance of various socioeconomic (education, income, house-ownership, household structure), demographic (age, gender, ethnicity) and geographic (population density, region, urban vs. rural areas) factors. Translating these research results into policy for best tackling the spread of the disease in current or future outbreaks of COVID-19 or other pandemics is essential. Although it is crucial to conduct research and translate science into policies as fast as possible during an ongoing pandemic, it is also important to remember that a substantial part of the literature including studies in our following review, comprises unpublished pre-prints and working papers that had not yet gone through standard peer-review.

Handwashing

Previous research shows that there are differences in handwashing practices between genders and people with different nationalities and different levels of education (Tan, Bakar, Abdul Karim, Lee, & Mahyudin, 2013). Using field observations of 3,749 people in college town environments in the US,

Borchgrevink, Cha, and Kim (2013) found that while women and elderly tended to engage in proper handwashing, people spend more time washing their hands when sink conditions are clean. During the COVID-19 outbreak, scholars found that both gender and household structure may impact hand hygiene (Zhang et al., 2020). A study of practices in hand hygiene for primary schoolchildren in Wuhan showed that gender, grade, whether people left their house/apartment during the lockdown period, father's occupation, mother's education and when the survey was filled out were significantly correlated with hand hygiene (X. Chen et al., 2020). Hygiene practices of UK citizens were associated positively with age and income, while being male, non-Christian, non-religious, and suburban were associated with a decrease in hygienic practices (Gibson Miller et al., 2020). In Malaysia, researchers identified significant associations between proper hand hygiene and gender, age, residence region and occupation. Females, those living in the Central region, people between 18 and 29 years old and students were more likely to have good hand hygiene. Those who were less likely to practice good hygiene were those above 50, residents in the Eastern region and retirees (Azlan, Hamzah, Sern, Ayub, & Mohamad, 2020). In Korea, handwashing was associated with females, participants who reported being worried, and those who live in metropolitan cities (Jang, Jang, & Lee, 2020). In summary, research on handwashing practices, especially in studies considering the early spread of COVID-19, frequently showed associations with age and sex. The relationship is often, although not consistently, positive with age, while results typically showed that females were more likely to have good hand hygiene practices than males. Analyses of rural/urban or regional differences suggested less hand hygiene practices in suburban areas and more in metropolitan areas. Other variables such as occupation, education, and environmental or household conditions were less studied or reported at the time of this review, making trends difficult to observe.

Social distancing and mask-wearing

Studies from the early phase of COVID-19 pandemic identified several important determinants for complying with distancing policies and use of masks. Many of the same determinants were observed across different countries. For example, in China, gender, occupation and COVID-19 knowledge scores were important predictors for whether people stay away from crowded places. Gender, marital status, residence province and knowledge level were significantly associated with wearing a mask outside (Zhong et al., 2020). In Wuhan, children's mask-wearing practices correlated with grade, mother's educational background, and place of residence (X. Chen et al., 2020). Another study confirmed the regional (rural/urban) differences in China, when considering compliance with avoiding social gathering and wearing masks outside (Y. Chen et al., 2020). In Korea, mask-wearing was associated with females, participants who reported being worried, and those who live in metropolitan cities (Jang

et al., 2020). This same study also found that urban residents to a lesser extent practiced social distancing during earlier survey periods, but reported more frequent mask-wearing in later survey waves (Jang et al., 2020). Some similar findings were observed in Malaysia: avoiding crowded places was significantly associated with age, income and knowledge scores, while gender, age, region, occupation and income was associated with wearing masks when leaving home (Azlan et al., 2020). Gender, age, residency and socioeconomic status have been recognised as playing substantial roles in social distancing measures in the West. Studies in the US showed that males, younger persons and people in rural communities were wearing masks less than other groups (Brandén et al., 2020). In the UK, the ability to comply with social distancing and the ability to self-isolate was lower among the most economically disadvantaged (Atchison et al., 2020). Adoption of social distancing measures was higher among those greater than 70 years old compared to younger adults, and for married people. The ability to self-isolate was lower among Black and minority ethnic groups, and correlated with lower education, lower income, people with less savings, and those who rent their home (Atchison et al., 2020). To summarise, although there were some variations across countries, to a large extent, increased social distancing behaviours and mask-wearing were positively associated with certain demographic traits (older age, female, urban residence) and higher socioeconomic status (more education and higher income).

Work from home

In studies early during the COVID-19 pandemic, remote work was associated with higher socioeconomic status variables such as higher education and higher income (Alipour, Falck, & Schüller, 2020; Baker, 2020; Dingel & Neiman, 2020), as well as certain occupation types (Alipour et al., 2020; Barbieri, Basso, & Scicchitano, 2020; Hensvik, Le Barbanchon, & Rathelot, 2020). People with occupations that are difficult to perform from home were less likely to be white and were more likely to be single and of immigrant backgrounds and to have lower education, lower income, no employer-provided healthcare and less stable jobs or recently experienced being unemployed (Maloney & Taskin, 2020; Mongey, Pilossoph, & Weinberg, 2020). In Norway, remote work was correlated with higher education, older age, and being female. On the other hand, low-skilled young people, single parents and immigrants were less likely to have access to remote-friendly jobs. There was also a regional difference: cities and regions with higher population density had larger percentages of jobs that could be done from home (Holgersen, Jia, & Svenkerud, 2020). In the UK, being able to work from home was correlated with higher education, higher income, more savings, and people who own their own houses (Atchison et al., 2020). In general, workers that cannot work from home tended to be lower paid than workers who can work from home (Atchison et al., 2020; Baker, 2020; Dingel & Neiman, 2020; Irlacher

& Koch, 2020; Mongey & Weinberg, 2020). In other words, most research on this topic focused on income, education and occupation type as explanatory variables, and demonstrated that people who were already disadvantaged were less able to comply with preventive measures such as social distancing, stay-at-home or shelter-in-place policies. Occasionally studies also looked at variables such as race, immigrant status, employment history and marital status, all of which are likely to be correlated with employment, income and education opportunities.

Travel and use of public transportation

Socioeconomic status and work circumstances constrained the ability to stay at home during the early days of the COVID-19 pandemic, as well as different social groups' ability to avoid travelling during the outbreak. People with lower paid occupations and lower access to cars were often not able to work from home and so continued to use public transportation to a greater extent (De Vos, 2020; Goldbaum & Cook, 2020). Mobility was therefore not as reduced in poorer neighbourhoods compared to richer areas. For example, in New York, more frequent usage of subways was found in areas with lower median incomes, greater proportions of non-white residents and greater percentages of essential workers and healthcare workers (Sy, Martinez, Rader, & White, 2020). Furthermore, travel intensity declined considerably less among those who have lower education and lower income, even when accounting for neighbourhood variations (Brough, Freedman, & Phillips, 2020). In the US, Black people often had more challenges with maintaining physical distancing and self-quarantine because more Black people tended to use public transit and were more likely to live in poorer neighbourhoods or densely populated areas (Chen & Krieger, 2020; Turner-Musa, Ajayi, & Kemp, 2020). Coven and Gupta (2020) pointed out that residents of richer neighbourhoods in New York were substantially more likely to leave the city, while people in low-income, Black, and Hispanic neighbourhoods, who were more likely to be frontline workers, exhibited more work activity during the day and had fewer possibilities to work remotely. These neighbourhoods also exhibited less sheltering-in-place outside work hours (Coven & Gupta, 2020). Based on smartphone location data in the US, researchers found that mobility for people in the lowest 10% income groups was still high during quarantine, while richer people stayed home to a larger extent (Buchanan, 2011; Takian, Kiani, & Khanjankhani, 2020). As with the studies on working from home and perhaps because of the likely relationship between this practice and the use of public transportation, studies focused on income and education, as well as race. Generally speaking, people with lower levels of income and education, especially members of non-white populations, were less able to comply with the recommended NPIs.

Data and methods:

Survey design

Our data comes from a nationally representative cross-sectional survey of the working-age Norwegian population (18–68 years), the YS Employment Outlook Survey (YS EOS), which has been administered annually since 2009 (n = 3,000 per year) (Bergene & Mamelund, 2015). The inclusion criterion for participation is that the respondent must work at least 40% of a full-time job, equivalent to two full days per week. The response rate in the 2020 survey was 39.1%, about the same level as in previous years.

Sampling in the YS EOS is stratified by age, sex and educational level to ensure the representativeness of the gross sample. The YS survey provides snapshots of the current state of Norwegian working life (e.g. union membership, wage formation, working environment, equal rights and labor market relations, job security, long-term sickness leaves, and job market prospects and employability), and it also includes information for respondents on household size, number of children, personal and household income, management role, temporary/permanent employment, private/public sector employment, size of the workplace, economic sector, and county.

In 2020, we added questions to the YS EOS Survey on 1) morbidity from COVID-19; 2) COVID-19 medical risk factors; 3) use of NPIs at the individual and workplace level, guided by WHO:[2] personal protection (hand and coughing hygiene, mask-wearing), environmental (washing of surfaces), social distancing (keeping 1 m distance, flexible working hours, canceling meetings, working from home, telework) and travel measures (e.g. less public transport use); and 4) pandemic consequences for labor market outcomes. We will address the social inequalities in morbidity and labor market consequences in future research.

Data collection procedure and the 2020 sample

Responses were collected between 24 March and 20 April using a panel set up by Kantar TNS Institute of Analysis and Sample Surveys. The collection of responses to the survey began 12 days after the lockdown on 12 March and stopped coincidentally on the same day the government started the gradual opening of Norway on 20 April (see Figure 1 above). Thus, the respondents answered the survey questions during the initial peak of the first wave of the pandemic in Norway, and in terms of the suggested use of NPIs, during a period of lockdown. The 2020 gross sample of the YS EOS included 7,672 respondents, with a net sample of 3,002 respondents (39.1% response rate).

[2] https://www.who.int/influenza/publications/public_health_measures/publication/en/

Dependent and independent variables

We asked the respondents two COVID-19 NPI questions: "Have you taken any of the following measures in a private context to avoid the spread of the coronavirus?" and "Have you taken any of the following measures in a workplace context to avoid the spread of the coronavirus?" The respondents were asked to report any of the following measures displayed in Table 1:

Table 1. Protective measure categories in the YS EOS 2020 survey

NPIs in a private context	**NPIs in a work context**
Washed hands/used disinfectants more often	Washed hands/used disinfectants more often
Used protective equipment such as facemasks	Used protective equipment such as facemasks
Been more careful with washing and cleaning	Generally been more careful with washing and cleaning
Cancelled or postponed physical meetings/gatherings	Cancelled or postponed conferences/physical meetings/gatherings
Cancelled/postponed leisure travel/ holiday trips	Cancelled/postponed travel
Kept at least one meter distance from family and friends	Kept at least one meter distance from customers, users, colleagues
Kept at least one meter distance from other persons	Used phone calls/video conferencing instead of meeting physically
Stayed away from crowds	Had flexible working hours to reduce density among employees
	Worked from home (had home office) more than usual
Used less public transport than usual	Used less public transport to work than usual
Bought more food, medicine, or equipment than usual	
Other, please write (open answer)	
No, not done any of the above	No, not done any of the above

Out of the various questions on NPI uptake, we chose the following as our *dependent variables* for further logistic regression analyses: handwashing (private), keeping 1m distance from others (private), use of protective equipment such as masks (private), home office (work), and public transportation (both contexts, analyzed separately). These were selected for the following reasons: 1) they were among the important public health recommendations, thus enabling potentially actionable findings; 2) previous literature suggested that there are often associations between these measures and socioeconomic status; 3) preliminary bi-variate chi-square tests were statistically significant; 4) some of the NPIs possibly reflect individual choice such as handwashing or social distancing in private context, while others might be more imposed or forced by choices or policies of employers and/or the government (e.g. home office). In particular, this is why both contexts are considered for public transportation, as the decision-making process and necessity for traveling to work is likely different than those for private travel; and 5) we assumed that several NPIs would be highly correlated (e.g.

working from home and using more video conferencing) and so measure similar associations and levels of compliance. We therefore focused on ones that might be considered "umbrella" NPIs that encompass additional changes in behavior.

The independent variable in the analyses is household income and was constructed for the following levels of household income in thousands of NOK (approximate USD in parenthesis): Under 600 (under 57k), 600-799 (57-76k), 800-999 (76-95k), 1000-1199 (95-114k), 1200 and over (115+k).[3] Due to the findings in previous studies on the association of NPI use and demographic characteristics, we added controls for age (under 30, 30-44, 45-59, 60+), sex (male, female), regions (Oslo and surroundings, rest of eastern Norway, south and western Norway, mid- and northern Norway), highest completed education (primary school, junior high school, upper secondary (vocational), upper secondary (general), bachelor's degree, master's degree or higher). A control for region is potentially important because the pandemic primarily had its epicenter in the capital city of Oslo in the spring and winter of 2020.

Analytical Strategy and statistical methods

Our analysis proceeded in two steps. First, as mentioned above, chi-square tests were used in initial exploration to uncover potential associations between the various NPIs and socioeconomic status. In this phase, we also used weights to account for underrepresented parts of the population. Second, after choosing the dependent variables listed above, we ran multivariate logistic regression models with 95% confidence intervals. The models examined the independent associations between income and the selected NPIs, controlling for age, sex, region and education. In the interest of space, only the regression phase of analysis is presented and discussed here.

Results

Descriptive findings

Table 1 shows the descriptive statistics of the sample by the independent variable as well as the control variables in the analysis. The sample is fairly balanced by sex (48% women), workers in midlife make up most of the sample (44% is 45-59 years), and the shares of the sample coming from the four regions vary between 20 and 30%. Finally, workers from both higher and lower levels of income and education are represented.

[3] Using the March 31, 2020 conversion rate of 1 USD = 10.47 NOK from https://fiscal.treasury.gov/reports-statements/treasury-reporting-rates-exchange/historical.html

Table 1. Descriptive statistics of the independent variable and control variables used in the analysis

Covariates	n (%)
n=	3002
Household income (1000 NOK)	
Under 600	543 (18.1)
600-799	380 (12.7)
800-999	506 (16.9)
1000-1199	499 (16.6)
1200+	641 (21.4)
No answer/No information	433 (14.4)
Sex	
Male	1562 (52.0)
Female	1440 (48.0)
Age Group	
Under 30	307 (10.2)
30-44	793 (26.4)
45-59	1326 (44.2)
60+	576 (19.2)
Region	
Oslo & surrounding areas	831 (27.7)
Rest of Eastern Norway	606 (20.2)
South-Western Norway	938 (31.2)
Mid- and Northern Norway	563 (18.8)
No information	64 (2.1)
Highest Level of Completed Education	
Primary school	96 (3.2)
Junior high school	360 (12.0)
Upper secondary (vocational)	676 (22.5)
Upper secondary (general)	398 (13.3)
Bachelor's degree	804 (26.8)
Master's degree or higher	668 (22.3)

Table 2 shows the distributions (n and %) of the dependent variables by three response alternatives, "checked", "not checked", and "no response". Almost all respondents washed their hands more often (94%) and followed the advice of keeping 1m from others (91%). As expected, quite few used masks (7%). More than half of the sample worked from home more than usual (53%). Finally, a greater proportion used less public transportation for private purposes (45%) than for commuting to work (23%). Fewer people checked the public transportation questions, especially for the work context, than the home office question. This is probably a reflection of Norway having only one big city with a large public transportation network of trains, buses, electric trams and subways (Oslo & surroundings) and that two out of three Norwegians live in other areas with smaller cities and rural areas where they rely more on private transportation to work.

Table 2. Distributions of the dependent variables by responses (n and %).

NPI	Responses, n (%)		
n = 3002	Checked	Not Checked	No Response
Washed hands more (private)	2806 (93.5)	188 (6.3)	8 (0.3)
Kept 1m from others (private)	2722 (90.7)	272 (9.1)	8 (0.3)
Used PPE, e.g. masks (private)	217 (7.2)	2777 (92.5)	8 (0.3)
Worked from home more (work)	1587 (52.9)	1391 (46.3)	24 (0.8)
Used less public transportation (private)	1357 (45.2)	1637 (54.5)	8 (0.3)
Used less public transportation (work)	700 (23.3)	2278 (75.9)	24 (0.8)

Logistic Regressions

In the interest of space, table 3 summarizes the results of the full models only, i.e. all control variables are included. Socioeconomic status, as measured by income, is a significant predictor of handwashing, keeping 1m distance, working from home and using less public transportation (work context only), even when controlling for related variables. The full model for mask-wearing is not significant. While the full model for using less public transportation in the private context is significant, income is not independently associated with the outcome when all control variables are included. Findings for each dependent variable, in particular the effects of control variables, are discussed further below.

Table 3. Multivariate analysis of the associations between NPI adoption and socioeconomic status.

	Reported washed hands more often		**Reported kept 1m from others**		**Reported wearing masks**		**Reported worked from home more often**	
	n (%)	Adj. OR (95% CI)	n (%)	Adj. OR (95% CI)	n (%)	Adj. OR (95% CI)	n (%)	Adj. OR (95% CI)
Household income (1000 NOK)								
Under 600	486 (92.0)	Reference	475 (90.0)	Reference	43 (8.1)	Reference	198 (37.6)	Reference
600-799	336 (90.8)	.868 (.536-1.405)	330 (89.2)	.914 (.586-1.426)	27 (7.3)	.849 (.511-1.408)	178 (48.6)	**1.595 (1.189-2.140)**
800-999	457 (92.9)	1.179 (.732-1.897)	443 (90.0)	1.012 (.664-1.543)	32 (6.5)	.753 (.464-1.221)	241 (49.3)	**1.702 (1.297-2.234)**
1000-1199	465 (95.5)	**1.854 (1.077-3.193)**	445 (91.4)	1.108 (.713-1.720)	32 (6.6)	.759 (.467-1.233)	286 (58.8)	**2.169 (1.648-2.855)**
1200K+	600 (95.5)	**1.864 (1.106-3.140)**	592 (94.3)	**1.622 (1.017-2.587)**	40 (6.4)	.712 (.442-1.144)	440 (70.4)	**2.929 (2.227-3.851)**
Age								
Under 30	223 (91.8)	Reference	211 (86.8)	Reference	18 (7.4)	Reference	120 (50.2)	Reference
30-44	616 (91.4)	.864 (.502-1.486)	592 (87.8)	1.071 (.682-1.681)	45 (6.7)	.911 (.512-1.622)	387 (57.9)	1.079 (.777-1.499)
45-59	1039 (94.4)	1.284 (.743-2.217)	1026 (93.2)	**2.031 (1.281-3.220)**	69 (6.3)	.896 (.514-1.563)	605 (55)	1.255 (.916-1.720)
60+	466 (95.7)	1.801 (.936-3.465)	456 (93.6)	**2.330 (1.355-4.006)**	42 (8.6)	1.336 (.738-2.419)	231 (47.5)	1.002 (.707-1.421)
Sex								
Male	1236 (92.0)	Reference	1193 (88.8)	Reference	93 (6.9)	Reference	743 (55.5)	Reference
Female	1108 (95.4)	**1.925 (1.360-2.725)**	1092 (94.1)	**2.121 (1.563-2.877)**	81 (7.0)	.996 (.726-1.366)	600 (51.9)	1.107 (.926-1.323)
Region								
Oslo & surr.	639 (92.7)	Reference	627 (91.0)	Reference	40 (5.8)	Reference	444 (64.7)	Reference
Rest of Eastern	495 (94.3)	1.330 (.823-2.149)	489 (93.1)	1.398 (.900-2.170)	40 (7.6)	1.394 (.878-2.212)	263 (50.2)	**.703 (.544-.909)**
South-Western	747 (93.5)	1.266 (.835-1.920)	717 (89.7)	.992 (.691-1.424)	67 (8.4)	**1.590 (1.050-2.407)**	391 (49.1)	**.680 (.539-.858)**
Mid- and Northern	463 (94.1)	1.297 (.801-2.100)	452 (91.9)	1.202 (.785-1.842)	27 (5.5)	.983 (.592-1.633)	245 (50.3)	**.631 (.485-.821)**
Education								
Primary school	74 (92.5)	Reference	71 (88.8)	Reference	3 (3.8)	Reference	21 (26.9)	Reference
Junior high school	282 (94.0)	1.231 (.466-3.255)	271 (90.3)	1.228 (.547-2.757)	23 (7.7)	2.300 (.669-7.913)	136 (45.3)	**1.957 (1.115-3.436)**
Upper secondary (vocational)	522 (92.6)	.985 (.401-2.423)	500 (88.7)	1.036 (.488-2.200)	31 (5.5)	1.539 (.457-5.181)	174 (31.1)	1.138 (.662-1.958)
Upper secondary (general)	306 (93.9)	1.147 (.440-2.993)	299 (91.7)	1.421 (.631-3.199)	27 (8.3)	2.420 (.711-8.233)	125 (38.3)	1.476 (.843-2.585)
Bachelor's degree	637 (93.8)	1.384 (.558-3.433)	630 (92.8)	2.103 (.970-4.559)	49 (7.2)	2.305 (.694-7.658)	439 (64.7)	**4.358 (2.542-7.472)**
Master's or higher	523 (94.1)	1.381 (.543-3.512)	514 (92.4)	1.907 (.864-4.210)	41 (7.4)	2.515 (.747-8.471)	448 (81.3)	**9.231 (5.266-16.183)**
Total n=		2505		2505		2505		2493

-2 log likelihood		1153.504		1417.822		1245.984		2948.470
Nagelkerke R^2		.044		.064		.018		.240

Table 3 *continued*.

	Reported using less public transportation (private)		**Reported using less public transportation (work)**	
	n (%)	Adj. OR (95% CI)	n (%)	Adj. OR (95% CI)
Household income (1000 NOK)				
Under 600	224 (42.4)	Reference	99 (18.8)	Reference
600-799	152 (41.1)	1.024 (.768-1.365)	80 (21.9)	1.247 (.881-1.763)
800-999	208 (42.3)	1.120 (.858-1.461)	101 (20.7)	1.187 (.857-1.644)
1000-1199	224 (46.0)	1.221 (.935-1.595)	116 (23.9)	1.333 (.968-1.836)
1200K+	325 (51.8)	1.270 (.978-1.649)	190 (30.4)	**1.439 (1.060-1.954)**
Age				
Under 30	126 (51.9)	Reference	66 (27.6)	Reference
30-44	330 (49.0)	.851 (.620-1.167)	150 (22.5)	**.692 (.483-.992)**
45-59	458 (41.6)	**.720 (.532-.976)**	250 (22.7)	.868 (.614-1.225)
60+	219 (45.0)	.859 (.614-1.202)	120 (24.7)	.991 (.677-1.450)
Sex				
Male	567 (42.2)	Reference	330 (24.7)	Reference
Female	566 (48.8)	**1.485 (1.251-1.762)**	256 (22.2)	.933 (.765-1.138)
Region				
Oslo & surr.	466 (67.6)	Reference	278 (40.5)	Reference
Rest of Eastern	183 (34.9)	**.286 (.223-.365)**	84 (16.0)	**.311 (.233-.413)**
South-Western	293 (36.7)	**.322 (.258-.401)**	132 (16.6)	**.339 (.264-.434)**
Mid and Northern	191 (38.8)	**.322 (.251-.413)**	92 (18.9)	**.371 (.281-.491)**
Education				
Primary school	26 (32.5)	Reference	11 (14.1)	Reference
Junior high school	138 (46.0)	1.598 (.928-2.751)	76 (25.3)	1.990 (.981-4.036)
Upper secondary (vocational	180 (31.9)	1.004 (.596-1.690)	73 (13.0)	.988 (.491-1.986)

Upper secondary (general)	121 (37.1)	1.208 (.703-2.076)	57 (17.5)	1.325 (.648-2.712)
Bachelor's degree	328 (48.3)	**1.807 (1.078-3.029)**	171 (25.2)	1.971 (.998-3.895)
Master's or higher	340 (61.2)	**2.776 (1.639-4.703)**	198 (35.9)	**2.945 (1.483-5.847)**
Total n=		2505		2493
-2 log likelihood		3149.600		2497.117
Nagelkerke R^2		.151		.128

Handwashing: Only the two highest income levels reported significantly higher odds ratios for washing hands more often versus the lowest income category. Sex also contributes with females having a higher odds ratio than males. We found no significant differences for age, region or education level.

Keeping 1m distance from others: The workers with the highest income level reported increased use of this NPI compared to workers with the lowest incomes. Individuals older than 45 years and females report higher odds ratios for keeping 1m distance from others. There were no significant differences by region or education level.

Mask use: The odds ratio suggests there was higher reported mask use in the south-western region of Norway compared to Oslo and surroundings. As noted, however, the model as a whole was not significant.

Home Office: There is a trend of increased use of this NPI across all income categories. Significant regional differences are seen between the Oslo area and all other parts of Norway. Level of education is an important contributor too, with particularly high odds ratio of reporting working from home for those with a bachelor's and master's degree.

Less public transportation (private context): Although household income did not have an independent effect on this NPI, age (to a limited extent), sex, region, and higher education did. Females had significantly higher odds ratio of reporting less use than males. All regions outside Oslo had significantly lower odds ratios, which is likely related to less availability of public transportation outside of larger cities. Further, there was a significantly higher odds ratio for reporting using less public transportation in a private context among workers with a bachelor's or master's degree.

Less public transportation (work context): The highest income and education groups reported increased use of this NPI. Age (30-44 years) and region also help explain the variation. Again, all regions outside of Oslo were less likely to report using less public transportation. Sex was not a significant predictor for using less transportation for work.

For the last three NPIs, it is important to keep in mind the relationship between working from home and reduced use of public transportation for work purposes. Chi-square results show a significant association between these variables ($X^2 = 95.742$, $p < .05$).

The pseudo R-squares (Nagelkerke R^2) which measure the fit of the multivariate models are very small in some of the models (less than 0.06%). These low values are probably due to either very high NPI uptake overall but small variations by socioeconomic status (e.g. for washing hands or keeping 1m distance) or low NPI uptake overall and small variation by SES (e.g. mask use). However, the explained variance in the models for using less public transportation is respectively 13% (work) and 15% (private);

here the overall share adopting this NPI quite high, respectively 23% (work) and 45% (private), and the differences by SES are also moderate (private: 42% lowest income vs. 52% highest income; work: 19% lowest income vs. 30% highest income). Finally, the explained variance in the multivariate model for working from home more often is quite high (24%); here the overall share adopting this NPI measure is high (53%) and the variation in doing so was quite substantial by income group (38% in the lowest vs. 70% in the highest).

Discussion:

We used survey data from a representative sample of the Norwegian working population to analyze social inequalities in adopting various NPIs in a private or work context during the first wave of COVID-19 in the winter and spring of 2020. In general, the higher income groups were more likely to report following the official recommendations regarding handwashing, social distancing and using less public transit, while the intermediate income groups were not significantly different in their NPI compliance relative to the reference group of lowest income. Only working from home showed significant differences for the intermediate income groups as well.

The data cannot tell us why this is the case, although it is possible to speculate about plausible explanations. For example, people with higher incomes will likely have a better *ability* to adopt NPIs and deal with potential associated costs. For example, people with lower incomes who cannot work from home also may be unable to reduce their use of public transportation, as they might not have cars or other alternatives. Similarly, masks, soap for handwashing, and other hygiene supplies could be prohibitively costly and might also be marked up in price due to demand. Additionally, one study found that the inability to work from home, a lack of paid sick leave, and income are associated with working adults' ability to comply with NPIs during a potentially serious influenza outbreak (Blake, Blendon, & Viswanath, 2010). There is a correlation between physical interaction and the ability to work from home (Bhorat, Thornton, Köhler, & Oosthuizen, 2020). Jobs in sectors such as technology, computing, management, administration, finance, engineering, and some sciences are typically higher paid than occupations which cannot be done at home. People of higher socioeconomic status thus often have “office occupations” and are thus more able to work from home. The remaining occupations in, for example, healthcare, manufacturing, retail and food services, transportation, industry, natural resources and construction are difficult to be performed from home and are more likely to be considered essential or critical (Almagro & Orane-Hutchinson, 2020; Dingel & Neiman, 2020). Our data includes information about economic sectors, but not exact occupations and tasks

done in the organization. Thus, a person working in healthcare, education or construction could be doing very different things from someone else in the same field. In future research, we nevertheless aim to study NPI compliance by sectors in more detail.

Secondly, an individual with higher socioeconomic status might have greater *intention* to comply with the NPI advice given by the authorities, perhaps due to greater health literacy or a more positive attitude toward healthcare providers and the health government (Howard, Sentell, & Gazmararian, 2006; Maurer, 2016). High socioeconomic status also implies access to money, knowledge, and power, all of which likely impact actual adherence to the NPIs suggested by the government (Phelan, Link, & Tehranifar, 2010).

Norwegians have no culture or history for mask use such as that seen in Asia after the SARS outbreak in 2002-03. The Norwegian Institute of Public Health, the Health Directorate and health politicians did not recommend mask use during the outbreak in the winter and spring of 2020. However, mask use was eventually recommended in Oslo in the fall and made mandatory in late September, if a person could not keep 1m distance when taking public transportation. As these recommendations occurred much later, they are not reflected in our results. At the time of the survey, very few people reported mask use, consistent with the then-current public health recommendations. The regression results for mask use by income based on survey data about the spread of the disease in the winter and spring of 2020 were therefore not significant.

Control variables included in our models were age, sex, region and education. There is some suggestion that reported NPI use might increase with age, although these results are generally not statistically significant. Female respondents reported increased use of NPIs in private contexts, but there were no sex differences for the work-context NPIs. Oslo tended to be different from other regions, in particular because 1) more people are dependent on using public transportation privately or for work purposes, and so fewer people might have alternative transportation options while at the same time there may be greater potential for an observable behavior *change* in use of public transportation during a crisis situation; and 2) more of the jobs in Oslo than in the rest of the country are in sectors such as technology, computing, management, administration, finance, engineering, and science occupations, where it is possible to work from home. Finally, education is an important variable to consider in light of socioeconomic differences. In the full models, significant results were seen for education in the home office and both public transportation NPIs, particularly when comparing respondents with university education compared to those with lower levels. Of note, higher income is associated with less public transportation (private context) to some extent in models 1-4 until education is added

(results not shown). When education is added to the home office model, the odds ratio for the highest income category notably drops from 4.038 (CI: 3.125-5.219) to 2.929 (CI: 2.227-3.851), meaning the effect of income on NPI use is reduced when considering individuals with similar education levels. These results suggest potential interactions between income and education in the adoption of NPIs. Additional regression models were performed where the independent variable was an ordinal scale classifying respondents as one of four combinations of low and high values (e.g. low income and low education level, low income and high education level, etc.). The results (not shown) had broadly similar patterns as those presented here, but trends generally followed the income scale for the low income/high education and high income/low education categories, justifying our choice of income as the independent variable. Nonetheless, future research will consider how alternative measures of socioeconomic status influence NPI use.

While our survey data is representative for Norwegian workers aged 18-68 years, and information on our independent variable (household income) and covariate controls (age, gender, region and education) come from population registers rather than being self-reported as in the survey questions, there are also some caveats to the study. First, our data do not include individuals younger than 18 years or older than 68 years, or individuals who are in the target age range but who are either self-employed or worked less than two full days per week. Second, as with all analyses relying on self-reported survey data, there is the issue of different interpretations of the NPI-related questions among the respondents and recall bias. The latter issue is probably less of a concern here as the respondents answered the questions during the first phase of the outbreak. Third, our data do not give an indication of absolute frequency of NPI use, e.g. someone who did not report washing their hands *more* might still actually wash their hands more often than someone who *did* report washing their hands more than usual. Similarly, if a respondent did not report using a particular NPI *more*, that does not mean they used it *less* frequently than usual. However, the underlying interest in our paper was behavior change in the context of COVID-19 and specifically the adoption of recommended NPIs, not typical behavior.

Perhaps the greatest limitation in our analyses is that our survey data do not give information on race, ethnicity or immigrant status. The international literature early in the pandemic has shown large disparities in pandemic disease outcomes by income, educational level, race and ethnicity (Batty et al., 2020; Dahal et al., 2020; Drefahl et al., 2020; Holmes et al., 2020; Sood & Sood, 2020; Williamson et al., 2020). Unfortunately, we are unable to report on any empirical associations between NPI use and these variables or to speculate whether a potentially lower level of NPI compliance among people of different racial, ethnic, or immigrant backgrounds could explain the observed disparities in the pandemic disease burden found in other studies internationally. However, even in Norway, preliminary

unpublished studies show immigrants are at a higher risk of infection, hospitalization and mortality.[4] Among the lab-confirmed cases, 28% were born outside Norway while this group makes up only 16% of the population. One explanation may be that the epicenter of the pandemic's first phase in 2020 was Oslo, where those born outside Norway make up a larger portion of the population than on average (28% vs 16%). Bias in terms of which groups are tested can also matter. There were also large east-west differences in lab-confirmed cases in Oslo, with more than two times higher case rates per 1000 in some of the hardest hit eastern parishes compared with some western ones. The east side of Oslo generally comprises a much higher share of immigrants than the west side.[5] The national data for risk of hospitalization, needing mechanical ventilation and death may also be higher for immigrants of Asian and African origin. Reasons for these disparities may include 1) increased exposure due to more household crowding, multigenerational living, or occupational circumstances (e.g. in some immigrant groups, being a taxi, tram or bus driver is common and also a risk factor for infection)[6]. These family-level and work-life contexts are less conducive for NPIs such as social distancing, working from home and using less public transit; 2) higher underlying susceptibility due to other pre-existing diseases (e.g. diabetes, obesity, lung and cardiovascular diseases, etc.); and 3) less health-seeking behavior, lower health literacy or other problems with accessing the advice about NPIs given by the authorities, for example due to less proficiency in the local language or because individuals seek information from other, perhaps unofficial sources.

Conclusion:

We studied to what extent socioeconomic status, as measured by income, was a significant predictor of adopting several of the recommended NPIs in both private and work contexts during the early spread of the COVID-19 pandemic in the winter and spring of 2020 in Norway. With the exception of mask-wearing and using less public transportation in a private context, all analyzed NPIs showed a clear and independent association with income controlling for age, sex, region and education. These social disparities in complying with central public health measures suggested by the government may be important drivers for the higher risks of infection, hospitalization and mortality for people of lower socioeconomic status documented in Norway and several countries during the COVID-19 pandemic. They also have important implications for the adoption of similar measures in lower income countries.

[4] https://www.fhi.no/contentassets/c9e459cd7cc24991810a0d28d7803bd0/covid-19-epidemien-kunnskap-situasjon-prognose-risiko-og-respons-i-norge-etter-uke-16-01.07.2020.pdf
[5] https://www.oslo.kommune.no/getfile.php/13373249-1593594139/Tjenester%20og%20tilbud/Koronavirus/Koronastatistikk/Statusrapport%20koronastatistikk%2030.6.20.pdf
[6] 2020-11-05-notat-om-risiko-og-respons.pdf (fhi.no)

Even after vaccines became available at the end of 2020 and early 2021, the use of NPIs are nevertheless important as vaccines were scarce and not necessarily available for all risk groups, especially not to all in low-income countries. Policy implications may include, for example, provision of supplies and/or financial supplements to lower income families, increased options or routes for public transportation, additional protective measures for individuals in lower paid occupational sectors who are unable to work from home, and targeted public health communications in multiple languages that also include efforts to reduce any potential stigmatization.

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References:

Alipour, J.-V., Falck, O., & Schüller, S. (2020). *Germany's Capacities to Work from Home* (13152). Retrieved from https://ideas.repec.org/p/iza/izadps/dp13152.html

Almagro, M., & Orane-Hutchinson, A. (2020). *The Determinants of the Differential Exposure to COVID-19 in New York City and Their Evolution Over Time* (ID 3573619). Retrieved from Rochester, NY: https://papers.ssrn.com/abstract=3573619

Atchison, C. J., Bowman, L., Vrinten, C., Redd, R., Pristera, P., Eaton, J. W., & Ward, H. (2020). Perceptions and behavioural responses of the general public during the COVID-19 pandemic: A cross-sectional survey of UK Adults. *medRxiv*, 2020.2004.2001.20050039. doi:10.1101/2020.04.01.20050039

Azlan, A. A., Hamzah, M. R., Sern, T. J., Ayub, S. H., & Mohamad, E. (2020). Public knowledge, attitudes and practices towards COVID-19: A cross-sectional study in Malaysia. *PLoS One, 15*(5). Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7241824/. doi:10.1371/journal.pone.0233668

Baker, M. G. (2020). Who cannot work from home? Characterizing occupations facing increased risk during the COVID-19 pandemic using 2018 BLS data. *medRxiv*, 2020.2003.2021.20031336. doi:10.1101/2020.03.21.20031336

Barbieri, T., Basso, G., & Scicchitano, S. (2020). *Italian Workers at Risk during the COVID-19 Epidemic* (ID 3572065). Retrieved from Rochester, NY: https://papers.ssrn.com/abstract=3572065

Batty, G. D., Deary, I., Luciano, M., Altschul, D., Kivimaki, M., & Gale, C. (2020). Psychosocial factors and hospitalisations for COVID-19: Prospective cohort study of the general population. *medRxiv*. doi:10.1101/2020.05.29.20100735

Bergene, A. C., & Mamelund, S.-E. (2015). Fit for fight? A cross-sectional study of union apathy in Norway. *Economic and Industrial Democracy*, 0143831X14566889. doi:10.1177/0143831X14566889

Bhorat, H., Thornton, A., Köhler, T., & Oosthuizen, M. (2020). *Jobs and COVID-19: Measuring Work-Related Physical Interaction* (DPRU Working Paper 202003). Retrieved from https://www.africaportal.org/publications/jobs-and-covid-19-measuring-work-related-physical-interaction/

Blake, K. D., Blendon, R. J., & Viswanath, K. (2010). Employment and Compliance with Pandemic Influenza Mitigation Recommendations. *Emerging Infectious Diseases, 16*(2), 212-218. Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2958001/. doi:10.3201/eid1602.090638

Bogg, T., & Milad, E. (2020). *Slowing the Spread of COVID-19: Demographic, Personality, and Social Cognition Predictors of Guideline Adherence in a Representative U.S. Sample*. Retrieved from https://osf.io/yc2gq

Borchgrevink, C. P., Cha, J., & Kim, S. (2013). Hand Washing Practices in a College Town Environment. *Journal of Environmental Health, 75*(8), 18-24.

Brandén, M., Aradhya, S., Kolk, M., Härkönen, J., Drefahl, S., Malmberg, B., . . . Mussino, E. (2020). Residential context and COVID-19 mortality among adults aged 70 years and older in Stockholm: a population-based, observational study using individual-level data. *The Lancet Healthy Longevity*. Retrieved from http://www.sciencedirect.com/science/article/pii/S2666756820300167. doi:https://doi.org/10.1016/S2666-7568(20)30016-7

Brough, R., Freedman, M., & Phillips, D. (2020). *Understanding Socioeconomic Disparities in Travel Behavior during the COVID-19 Pandemic* (ID 3624920). Retrieved from Rochester, NY: https://papers.ssrn.com/abstract=3624920

Buchanan, D. R. (2011). Should people with unhealthy lifestyles pay higher health insurance premiums? *The Journal of Primary Prevention, 32*(1), 17-21. doi:10.1007/s10935-011-0235-y

Chen, J. T., & Krieger, N. (2020). *Revealing the unequal burden of COVID-19 by income, race/ethnicity, and household crowding: US county vs ZIP code analyses* (Volume 19, Number 1). Retrieved from

Chen, X., Ran, L., Liu, Q., Hu, Q., Du, X., & Tan, X. (2020). Hand Hygiene, Mask-Wearing Behaviors and Its Associated Factors during the COVID-19 Epidemic: A Cross-Sectional Study among Primary School Students in Wuhan, China. *International Journal Of Environmental Research And Public Health, 17*(8), 2893. doi:10.3390/ijerph17082893

Chen, Y., Jin, Y. L., Zhu, L. J., Fang, Z. M., Wu, N., Du, M. X., . . . Yao, Y. S. (2020). The network investigation on knowledge, attitude and practice about COVID-19 of the residents in Anhui Province [基于网络的安徽省居民新型冠状病毒肺炎知识、态度、行为调查分析]. *中华预防医学杂志 [Chinese Journal of Preventive Medicine], 54*(4), 367-373. doi:10.3760/cma.j.cn112150-20200205-00069

Clements, J. M. (2020). Knowledge and Behaviors Toward COVID-19 Among US Residents During the Early Days of the Pandemic: Cross-Sectional Online Questionnaire. *JMIR public health and surveillance, 6*(2), e19161. doi:10.2196/19161

Coven, J., & Gupta, A. (2020). *Disparities in Mobility Responses to COVID-19* (Working Paper). Retrieved from

Dahal, S., Mizumoto, K., Rothenberg, R., & Chowell, G. (2020). Investigating spatial variability in COVID-19 pandemic severity across 19 geographic areas, Spain, 2020. *medRxiv*, 2020.2004.2014.20065524. Retrieved from https://www.medrxiv.org/content/medrxiv/early/2020/04/28/2020.04.14.20065524.full.pdf. doi:10.1101/2020.04.14.20065524

De Vos, J. (2020). The effect of COVID-19 and subsequent social distancing on travel behavior. *Transportation Research Interdisciplinary Perspectives, 5*, 100121. doi:10.1016/j.trip.2020.100121

Dingel, J. I., & Neiman, B. (2020). *How Many Jobs Can be Done at Home?* (26948). Retrieved from http://www.nber.org/papers/w26948

Drefahl, S., Wallace, M., Mussino, E., Aradhya, S., Kolk, M., Brandén, M., . . . Andersson, G. (2020). A population-based cohort study of socio-demographic risk factors for COVID-19 deaths in Sweden. *Nature Communications, 11*(1), 5097. Retrieved from https://doi.org/10.1038/s41467-020-18926-3. doi:10.1038/s41467-020-18926-3

Gibson Miller, J., Hartman, T. K., Levita, L., Martinez, A. P., Mason, L., McBride, O., . . . Bentall, R. P. (2020). Capability, opportunity, and motivation to enact hygienic practices in the early stages of the COVID‐19 outbreak in the United Kingdom. *British Journal of Health Psychology*.

Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7276910/. doi:10.1111/bjhp.12426
Goldbaum, C., & Cook, L. R. (2020, 2020/03/30). They Can't Afford to Quarantine. So They Brave the Subway. *The New York Times*. Retrieved from https://www.nytimes.com/2020/03/30/nyregion/coronavirus-mta-subway-riders.html
Hensvik, L., Le Barbanchon, T., & Rathelot, R. (2020). *Which Jobs Are Done from Home? Evidence from the American Time Use Survey* (13138). Retrieved from https://ideas.repec.org/p/iza/izadps/dp13138.html
Holgersen, H., Jia, Z., & Svenkerud, S. (2020). *Who and how many can work from home in Norway? Evidence from task descriptions* (ID 3580674). Retrieved from Rochester, NY: https://papers.ssrn.com/abstract=3635638
Holmes, L., Enwere, M., Williams, J., Ogundele, B., Chavan, P., Piccoli, T., . . . Dabney, K. W. (2020). Black–White Risk Differentials in COVID-19 (SARS-COV2) Transmission, Mortality and Case Fatality in the United States: Translational Epidemiologic Perspective and Challenges. *International Journal Of Environmental Research And Public Health, 17*(12), 4322. Retrieved from https://www.mdpi.com/1660-4601/17/12/4322.
Howard, D. H., Sentell, T., & Gazmararian, J. A. (2006). Impact of health literacy on socioeconomic and racial differences in health in an elderly population. *Journal of General Internal Medicine, 21*(8), 857-861. Retrieved from https://doi.org/10.1111/j.1525-1497.2006.00530.x. doi:10.1111/j.1525-1497.2006.00530.x
Irlacher, M., & Koch, M. (2020). *Working from Home, Wages, and Regional Inequality in the Light of COVID-19* (8232). Retrieved from https://ideas.repec.org/p/ces/ceswps/_8232.html
Jang, W. M., Jang, D. H., & Lee, J. Y. (2020). Social Distancing and Transmission-reducing Practices during the 2019 Coronavirus Disease and 2015 Middle East Respiratory Syndrome Coronavirus Outbreaks in Korea. *Journal of Korean Medical Science, 35*(23). Retrieved from https://doi.org/10.3346/jkms.2020.35.e220. doi:10.3346/jkms.2020.35.e220
Maloney, W., & Taskin, T. (2020). *Determinants of Social Distancing and Economic Activity during COVID-19: A Global View* (9242). Retrieved from https://elibrary.worldbank.org/doi/abs/10.1596/1813-9450-9242
Maurer, J. (2016). Inspecting the Mechanism:A Longitudinal Analysis of Socioeconomic Status Differences in Perceived Influenza Risks, Vaccination Intentions, and Vaccination Behaviors during the 2009–2010 Influenza Pandemic. *Medical Decision Making, 36*(7), 887-899. Retrieved from https://journals.sagepub.com/doi/abs/10.1177/0272989X15608379. doi:10.1177/0272989x15608379
Mongey, S., Pilossoph, L., & Weinberg, A. (2020). Which Workers Bear the Burden of Social Distancing Policies? *National Bureau of Economic Research Working Paper Series*. Retrieved from https://www.nber.org/papers/w27085.
Mongey, S., & Weinberg, A. (2020). *Characteristics of workers in low work-from-home and high personal-proximity occupations*. Retrieved from
Nivette, A., Ribeaud, D., Murray, A. L., Steinhoff, A., Bechtiger, L., Hepp, U., . . . Eisner, M. (2020). *Non-compliance with COVID-19-related public health measures among young adults: Insights from a longitudinal cohort study*. Retrieved from https://osf.io/8edbj
Phelan, J. C., Link, B. G., & Tehranifar, P. (2010). Social Conditions as Fundamental Causes of Health Inequalities: Theory, Evidence, and Policy Implications. *Journal of Health and Social Behavior, 51*(1_suppl), S28-S40. Retrieved from https://journals.sagepub.com/doi/abs/10.1177/0022146510383498. doi:10.1177/0022146510383498
Raude, J. (2020). *Determinants of preventive behaviors in response to the COVID-19 pandemic in France: comparing the sociocultural, psychosocial and social cognitive explanations*. Retrieved from https://osf.io/4yvk2
Sood, L., & Sood, V. (2020). Being African American and Rural: A Double Jeopardy From COVID-19. *The Journal of rural health : official journal of the American Rural Health Association and the*

National Rural Health Care Association, 10.1111/jrh.12459. Retrieved from https://pubmed.ncbi.nlm.nih.gov/32362036

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7267160/. doi:10.1111/jrh.12459

Sy, K. T. L., Martinez, M. E., Rader, B., & White, L. F. (2020). Socioeconomic disparities in subway use and COVID-19 outcomes in New York City. *medRxiv*, 2020.2005.2028.20115949. doi:10.1101/2020.05.28.20115949

Takian, A., Kiani, M. M., & Khanjankhani, K. (2020). COVID-19 and the need to prioritize health equity and social determinants of health. *International journal of public health*. Retrieved from https://doi.org/10.1007/s00038-020-01398-z. doi:10.1007/s00038-020-01398-z

Tan, S. L., Bakar, F. A., Abdul Karim, M. S., Lee, H. Y., & Mahyudin, N. A. (2013). Hand hygiene knowledge, attitudes and practices among food handlers at primary schools in Hulu Langat district, Selangor (Malaysia). *Food Control, 34*(2), 428-435. doi:10.1016/j.foodcont.2013.04.045

Turner-Musa, J., Ajayi, O., & Kemp, L. (2020). Examining Social Determinants of Health, Stigma, and COVID-19 Disparities. *Healthcare, 8*(2), 168. doi:10.3390/healthcare8020168

Vestergaard, L. S., Nielsen, J., Richter, L., Schmid, D., Bustos, N., Braeye, T., . . . Mølbak, K. (2020). Excess all-cause mortality during the COVID-19 pandemic in Europe – preliminary pooled estimates from the EuroMOMO network, March to April 2020. *Eurosurveillance, 25*(26), 2001214. Retrieved from https://www.eurosurveillance.org/content/10.2807/1560-7917.ES.2020.25.26.2001214. doi:doi:https://doi.org/10.2807/1560-7917.ES.2020.25.26.2001214

Williamson, E. J., Walker, A. J., Bhaskaran, K., Bacon, S., Bates, C., Morton, C. E., . . . Goldacre, B. (2020). Factors associated with COVID-19-related death using OpenSAFELY. *Nature, 584*(7821), 430-436. Retrieved from https://doi.org/10.1038/s41586-020-2521-4. doi:10.1038/s41586-020-2521-4

Zettler, I., Schild, C., Lilleholt, L., & Böhm, R. (2020). *Individual differences in accepting personal restrictions to fight the COVID-19 pandemic: Results from a Danish adult sample*. Retrieved from https://osf.io/pkm2a

Zhong, B.-L., Luo, W., Li, H.-M., Zhang, Q.-Q., Liu, X.-G., Li, W.-T., & Li, Y. (2020). Knowledge, attitudes, and practices towards COVID-19 among Chinese residents during the rapid rise period of the COVID-19 outbreak: a quick online cross-sectional survey. *International Journal of Biological Sciences, 16*(10), 1745-1752. doi:10.7150/ijbs.45221