**Non-compliance with COVID-19-related public health measures among young adults:
Insights from a longitudinal cohort study***

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Abstract

Background: Do young adults have low compliance rates with public health measures aimed at curbing the spread of Coronavirus disease 2019 (COVID-19)? This paper leverages a prospective-longitudinal cohort study with data before and during the pandemic to examine this question.

Methods: Data came from an ongoing cohort study (n=737). Non-compliance with public health measures and concurrent correlates were measured at age 22. Antecedent sociodemographic, social, and psychological factors were measured at ages 15-20.

Findings: Young adults generally complied with COVID-19 public health measures, although compliance with some measures (e.g., cleaning/disinfecting mobile phones, standing 1.5-2 meters apart) was relatively lower. Non-compliance, especially with hygiene-related measures, was more prevalent in males, and in individuals with higher education, higher SES, and a non-migrant background. Non-compliance was associated with “antisocial potential,” including pre-pandemic low acceptance of moral rules, legal cynicism, low shame/guilt, low self-control, engagement in delinquent behaviors, and association with delinquent peers. Young adults with low trust, including in the government’s measures for fighting the virus, also complied less.

Interpretation: In order to increase voluntary compliance with COVID-19 measures, public health campaigns should implement strategies that foster moral obligation and trust in authorities, or leverage trustworthy individuals in the community to disseminate information. For young adults with low self-control, self-monitoring, environmental restructuring, or nudging may increase compliance. Long-term investments into integrating antisocial youth into society may decrease rule-breaking behaviors, including during pandemics when compliance saves lives.

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Non-compliance with COVID-19-related public health measures among young adults: Insights from a longitudinal cohort study

During the initial weeks of the Coronavirus disease 2019 [COVID-19] outbreak in Europe, Switzerland was among the ten most affected countries worldwide, with one of the highest per capita rates of infection.¹ Public health recommendations were first introduced on 28 February; from 16 March to 26 April 2020, Switzerland went into its first country-wide “lockdown”. Policies during that time included increased social distance and hygiene, prohibition of social gatherings of >5 people, and staying home whenever possible.²⁻³

Adolescents and young adults were identified internationally as a group with potentially low compliance, especially with social distancing measures.⁴⁻⁵ In mid-March 2020, the WHO issued a special appeal to young people for increased compliance.⁶ This group often displays only mild or no symptoms of COVID-19, while still being infectious.⁷⁻⁸ Thus, their potential for spreading the virus is high, considering that they also tend to have large social networks and active social lives.⁹

Compliance research in this or previous pandemics has typically focused on proximal, concurrent correlates, including sociodemographic characteristics, perceived risk of contracting or being harmed by the virus, information-seeking, having trust in the government, and feeling the moral obligation to comply.¹⁰⁻¹³ Less is known about how prior social and psychological risk factors are associated with non-compliance during pandemics. In non-pandemic times, young people’s antisocial potential¹⁴—that is low self-control, high engagement in delinquent behaviors, high association with delinquent peers, low acceptance of moral rules, legal cynicism, and low shame or guilt—predicts future rule-breaking behaviors. This makes antisocial potential a strong candidate as a predictor of non-compliance with measures aimed at curbing the spread of the virus.

The predictive ability of antisocial potential is best examined using representative data featuring information on young people *before and during* the COVID-19 pandemic. The current analysis thus leverages a prospective-longitudinal study that began data collection years before the pandemic, and that most recently collected data in April 2020. During the COVID-19 pandemic, young adults reported their compliance with public health measures, and attitudinal and situational characteristics, such as risk-status, information seeking, and trust in government. Prior to the pandemic, these same participants were extensively characterized in terms of their sociodemographic characteristics and antisocial potential during their adolescent and young adult years. We use the data to describe patterns of compliance with COVID-19

related public health measures in young adults and to identify which characteristics of adolescents and young adults increase risk for future and concurrent non-compliance.

METHODS

Sample and Procedures

Data came from the Zurich Project on Social Development from Childhood to Adulthood (z-proso), an ongoing prospective-longitudinal study of child and adolescent development. The cohort comprises children who entered 1st grade in one of the 56 primary schools in Zurich, in 2004. The initial target sample of schools was selected using random sampling procedures in which disadvantaged school districts were oversampled. The study consists of eight waves of child interviews at ages 7, 8, 9, 11, 13, 15, 17, and 20. Details on the original sample selection and attrition between waves 1 and 7 are available elsewhere.¹⁵⁻¹⁶ Most recently, participants who had participated at the age 20 assessment were invited to participate in a COVID-19 online study at age 22 years old. The current analysis primarily uses data from the COVID-19, and the age 15, 17, and 20 assessments. Subjects provided written informed consent for their study participation at ages 13-20. At age 22, informed consent was obtained online, as an extension to the age 20 written consent. Until age 15, parents could opt their child out of the study.

The sample for the COVID-19 data collection was based on participants of the z-proso age 20 assessment. Out of the 1180 participants at age 20, 21 were not contacted due to unclear status or invalid contact information. Out of the 1159 cases contacted, N=786 participants responded (67.8% of age 20 sample in 2018; 46.9% of original target sample in 2004). Given attrition over time, sampling weights were used in all analyses to allow generalizations back to the original recruitment population (see Supplementary Appendix A for more details). We excluded those no longer living in Switzerland during the time of the survey and who had incomplete data on measures of interest here (final sample n=737). Descriptive characteristics of the weighted sample are reported in Table 1. Notably, 50% of the sample had a migrant background (i.e. both parents born abroad), which is largely representative of the youth population in Zurich.

At ages 15, and 17, participants completed paper/pencil questionnaires in classrooms outside of regular lesson times. At age 20, participants completed surveys on a computer at a university research laboratory. Interviews typically lasted 90 minutes. Adolescents received a cash incentive for their participation in each wave: ~\$50 at age 15, ~\$60 at age 17, and ~\$75

at age 20. Respondents in the age 22 COVID-19 survey were entered into a lottery with the opportunity to win one of 50 prizes of ~100\$.

Those who had participated at age 20 were sent an invitation with a personalized link by SMS and e-mail. Data collection began during week 4 of the Swiss lockdown and ended during week 5. Invitations were sent on 8 April 2020, with reminders on 11 and 13 April. In total, participants were given 7 days to complete the survey.

Ethical approval was obtained by the Ethics Committee of the Faculty of Arts and Social Sciences of the University of Zurich.

Measures

Dependent variable

Non-compliance with COVID-19 public health measures. Respondents were asked whether or not they adopted 13 protective behaviors, reflecting national and international recommendations.^{2-3,17} They can broadly be subdivided into hygiene measures (e.g., wash hands regularly, use hand disinfectant, cough into an elbow or cloth, do not touch face, wash hands after coughing or sneezing, disinfect mobile phone) and social distancing behaviors (e.g., stay at home, adhere to social distancing [1.5-2 meters]), stay at home with symptoms, avoid at-risk persons, do not shake hands). Wearing a face mask was included in the survey, but was excluded from analyses since this was explicitly not recommended by the Swiss government. Accordingly, only 8% of participants reported wearing a face mask.

For each of the 13 behaviors, respondents indicated whether they followed the recommendation. A sum score was created to reflect how many of the 13 behaviors the respondent failed to comply with. Separate sum scores were created for compliance with hygiene and social distancing measures, respectively.

Sociodemographic variables

We included a range of sociodemographic variables that are relevant for understanding protective health behaviors and non-compliance: sex, socioeconomic status [SES] and educational level measured at age 15, and migrant background (see Supplementary Appendix B for more details).

Antecedent variables

In order to evaluate antecedent predictors of COVID-19 non-compliance, we used information from the two previous waves of the z-proso study (ages 17 and 20). We briefly describe each

variable here; additional detail on the items used and the reliability of each scale is available in Supplementary Appendix B.

Weak social bonds and active lifestyle. Weak bonds may reflect an individual's reduced embeddedness in social networks and less exposure to social pressures to comply. In addition, an active social lifestyle may increase risk of non-compliance with social distancing measures. We used eight variables to measure elements of weak social bonds and social lifestyle: low parental involvement, low parental monitoring, low teacher-student bonds, low school commitment, low social support, perceived social exclusion, low generalized trust, and active social lifestyle (e.g. meeting with friends, practicing sports). Parent- and school-related variables were measured at age 17; exclusion, trust, and social lifestyle were measured at age 20.

Attitudes towards the law and police. We used two measures that capture attitudes towards the law and police (measured at age 20) which can be indicative of an individual's broader willingness to accept formal authorities and directives: low police legitimacy and legal cynicism.

Deviant peers and antisocial behavior. Two of the most important individual antecedents of rule-breaking are prior rule-breaking and affiliation with deviant peers.¹⁸⁻¹⁹ We therefore included measures of prior antisocial behavior and deviant peers measured at age 20.

Dispositional factors. We included three dispositional factors as important predictors of health and risk behaviors measured at age 20: low self-control, low self-efficacy, and low feelings of guilt or shame.^{12,20}

Concurrent variables

Two items were used to measure *risk of infection*. Respondents were asked whether they or a family member had a pre-existing condition that increases their risk or seriousness of infection. Two measures captured the respondent's broader perceptions about *low social compliance* (i.e. social norms) and *low moral norms* regarding whether certain non-compliant behaviors are wrong. The *COVID-19 moral disengagement* scale reflects attitudes that underestimate or dismiss the risk of infection. The *low trust in government* scale was included to capture the respondent's views on Swiss authorities in relation to the outbreak. Finally, *low information-seeking* was measured by a single item that asks respondents how often he/she sought out news or information about COVID-19 in the two weeks prior to the survey (see Supplementary Appendix B for additional details on the items used and reliability of each scale).

Analytical strategy

Compared to the previous wave (age 20), an attrition analysis showed significantly higher response rates in the age 22 COVID-19 survey by women compared to men, and in (local) German speakers compared to participants other linguistic backgrounds (which serves as a proxy indicator for migrant background). Therefore, sampling weights were used in all analyses to allow the generalization of results to the original target sample.

Analyses were conducted in two stages. All analyses used binomial generalized linear model [GLM] regressions with a logit-link function. Binomial regression techniques tend to perform better when analyzing sum scores (i.e. bounded count data) compared to traditional or Poisson regression approaches.²¹ First, we examined differences in compliance behaviors by sociodemographic characteristics. Specifically, we estimated the likelihood of each non-compliance behavior by sex, and then examined the likelihood of overall, hygiene, and social distancing non-compliance by education level, sex, SES quartiles, and migrant background. Estimates were computed using sampling weights, and adjusting for other sociodemographic characteristics. The odds ratios [ORs] therefore reflect the adjusted odds of an additional non-compliance behavior in a given group compared to the reference group. Unadjusted and adjusted estimates are available in Supplementary Appendix C.

Second, we estimated bivariate associations between both antecedent and concurrent factors with non-compliance. In these analyses, the sociodemographic characteristics described above were adjusted. The resulting ORs reflect the odds of an additional non-compliance behavior given a one-unit increase in the independent variable. All analyses were conducted accounting for sample weights.

Missing data was low, with missingness for most variables ranging from 0% (e.g., compliance items) to 3% (e.g., parental monitoring). Four variables with the highest missingness were teacher-child bond (9%), school commitment (9%), social exclusion (9%), and deviant peers (11%). In order to assess whether results were influenced by missing data, we conducted multiple imputation using chained equations, which can handle different types of complex (bounded) data.²² Using the variables included in the analyses as predictors, we imputed 10 complete datasets and re-estimated all analyses with full information (n=737). The substantive results remained the same, so we present the results for the listwise analyses (imputed results are available in the Supplementary Appendix D).

RESULTS

Prevalence of non-compliance by sociodemographic characteristics

Table 1 shows descriptive statistics for the weighted sample. Overall, non-compliance was relatively low: On average, respondents reported failing to comply with 2 to 3 (out of 13) COVID-19-related measures ($M=2.47$, $SE=0.07$). Non-compliance with hygiene-related COVID-19 measures was reported more often ($M=1.77$, $SE=0.05$) than non-compliance with social distancing measures ($M=0.71$, $SE=0.04$).

[Table 1]

Table 2 provides additional detailed information about average levels of non-compliance with each COVID-19 measure, stratified by sex. For the full sample, non-compliance varied across specific hygiene and social distancing measures. Non-compliance was more prevalent for certain hygiene measures, such as cleaning or disinfecting one's mobile phone (53%), washing one's hands after coughing or sneezing (53%), avoiding touching one's face (35%), and using hand disinfectant (27%). Conversely, non-compliance was low for coughing or sneezing into one's elbow (3%), and washing one's hands regularly (5%). Non-compliance for social distancing measures ranged from 3% (staying at home with symptoms) to 18% (adhering to 1.5-2 meter social distancing guidelines). Table 2 also shows that non-compliance is generally greater among males compared to females, however this varies by behavior. Specifically, there were no significant differences ($p>.05$) found for regular handwashing, adhering to social distancing guidelines, avoiding contact with people at risk, only using public transport when necessary, and staying at home with symptoms (see Table 2).

[Table 2]

Adjusted odds ratios for hygiene, social distancing, and overall COVID-19 non-compliance levels by sociodemographic characteristics are presented in Table 3. Males were 43% more likely to report an additional non-compliance behavior compared to females (overall non-compliance $OR=1.43$, $p<0.001$). Non-compliance with hygiene measures was lower in respondents from low and medium (i.e. $OR_{secondary\ A(medium)}=0.76$; $OR_{secondary\ B/C(low)}=0.63$) compared to higher educational backgrounds (i.e. Gymnasium). By contrast, respondents in the medium educational tracks (secondary A) were 42% ($p=0.060$) and respondents in the low educational track (secondary B/C) were 93% more likely ($p<0.001$) to report additional social distancing non-compliance behaviors compared to respondents with higher education (college-

track). Respondents with high SES were more likely to report hygiene non-compliance ($OR_{\text{Quartile4}(\text{high})}=1.63$, $p<0.001$), but there were no differences for social distancing non-compliance. Respondents with a migration background were 25% less likely to report additional hygiene non-compliance compared to respondents with at least one parent born in Switzerland, but there were no differences in social distancing non-compliance.

[Table 3]

Effects of antecedent and concurrent factors on non-compliance

Adjusted ORs and 95% confidence intervals for antecedent and concurrent factors on overall non-compliance are visualized in Figure 1. All point estimates, 95% confidence intervals, and p-values for unadjusted and adjusted effects are available in Supplementary Appendix C. Overall, several antecedents are consistently associated with both types of non-compliance, even when adjusting for sociodemographic factors: legal cynicism (overall $OR=1.27$, $p<0.001$), deviant peers (overall $OR=1.16$, $p<0.001$), antisocial behavior (overall $OR=1.10$, $p<0.001$), and low guilt/shame (overall $OR=1.19$, $p=0.003$). For example, with each additional antisocial behavior reported (e.g. steal something from a shop, take illegal drugs) the odds of reporting an additional non-compliance behavior increased by 10%. Concurrent factors associated with non-compliance included low feelings of moral obligation (overall $OR=1.48$, $p<0.001$), COVID-19 moral disengagement (overall $OR=1.82$, $p<0.001$), and low information-seeking behavior (overall $OR=1.13$, $p<0.001$).

[Figure 1]

Adjusted ORs and 95% confidence intervals for hygiene and social distancing non-compliance respectively are presented in Figure 2. The results suggested that certain antecedent and concurrent factors influence hygiene and social distancing non-compliance to different degrees. We did not identify factors that were robustly associated with hygiene non-compliance only. By contrast, other antecedent and concurrent factors appeared to be uniquely associated with social distancing non-compliance: low parental monitoring ($OR=1.47$, $p=0.003$), low police legitimacy ($OR=1.40$, $p<0.001$), low self-control ($OR=2.03$, $p<0.001$), and low trust in government ($OR=1.90$, $p<0.001$). Association between low generalized trust and non-compliance varied by type of behavior. Low generalized trust was associated with a lower

likelihood of hygiene non-compliance (OR=0.90, $p=0.074$), but an increased likelihood of social distancing non-compliance (OR=1.37, $p=0.002$).

[Figure 2]

DISCUSSION

Understanding characteristics of young people who do not comply with COVID-19-related public health measures is essential for developing effective public health campaigns in the current and future pandemics. We leveraged data from a longitudinal cohort study with data before and during the COVID-19 pandemic to examine antecedent and concurrent factors associated with non-compliance. Results showed that rates of compliance with COVID-19-related measures in a representative sample of young adults were relatively high, and slightly better for social distancing than hygiene measures. Non-compliance was higher among males, those with a higher education level, higher SES, and non-migrant background. These associations were primarily driven by associations with non-compliance in hygiene-related measures.

Analyses of antecedent and concurrent risk factors suggested that non-compliance was associated with a cluster of behaviours sometimes termed “antisocial potential”: low acceptance of moral rules, legal cynicism, low shame or guilt, low self-control, high engagement in delinquent behaviors, and association with delinquent peers.¹⁴ Public health measures have in the past appealed to social pressure and moral obligations to motivate compliance.¹³ Our results support these approaches. The factors related to antisocial potential are considered by some to be less malleable in the short term making them less suitable for intervention. Although it is unlikely that public health campaigns can effectively change an individual’s antisocial potential in emergency situations such as the current pandemic, it is possible to manage the effects of certain antisocial risk factors in the short term. For example, evidence suggests that the effect of low self-control can be attenuated by intervention strategies that aim to manage deficits in self-control through self-monitoring, environmental restructuring, or nudging.²³

In addition, our results suggest that hygiene and social distancing behaviors are in part driven by different mechanisms. For example, negative attitudes towards authorities (i.e. low police legitimacy, low trust in government) were associated with increased social distancing non-compliance but not hygiene non-compliance. This has important implications for public

health policies and campaigns that aim to motivate compliance with COVID-19-related measures. Compliance with social distancing measures involves greater or more restrictive behavioral change, with direct consequences for psychological, social, and economic well-being.^{4,24} Adopting these behavioral changes may therefore be perceived as too burdensome without adequate trust and belief that authorities are fair and effective in implementing restrictive rules. In addition, trust may indirectly motivate compliance by increasing an individual's perception of risk.¹²

Our results suggest that there are some areas of non-compliance that require additional attention from public health campaigns. Non-compliance with certain protective measures, such as avoiding groups, coughing or sneezing into one's elbow, and washing one's hands regularly, was generally low. This implies that the message was effectively disseminated and young people were generally receptive to these measures. However, non-compliance with certain hygiene and social distancing measures were relatively higher, including cleaning and disinfecting mobile phones or standing 1.5-2 meters apart. Cleaning mobile phones was not an "official" recommendation by Swiss authorities, which may partly explain lower levels of compliance regarding these hygiene measures. Nevertheless cleaning environmental surfaces, including mobile phones, has been recommended by international public health authorities and media outlets as a protective measure against the spread of the virus.^{17,25} Public health campaigns should address these aspects of non-compliance, for example by improving the awareness and understanding of the virus on smartphones and other methods of transmission.²⁶

Finally, analyses of non-compliance by sociodemographic characteristics indicated that males are less likely to comply with both hygiene and social distancing measures. This is an important finding given that the available evidence suggests that COVID-19 mortality rates are higher for men compared to women.²⁷ Furthermore, our results showed that non-migrant background and high-SES young people were less likely to comply with hygiene measures, but not social distancing measures. This may in part reflect what is known as the "immigrant health paradox," whereby first- and second-generation migrants tend to report fewer risky health behaviors and better health outcomes than natives.²⁸ Hygiene practices may also depend on situational, household, or occupational characteristics that may influence the risk of infection. For example, migrant background or low SES/education individuals may be more likely to work in service sector positions that are considered "essential", increasing exposure to environmental risks. Low SES or education groups also face higher barriers to compliance with social distancing rules, such as staying home or avoiding public transport, due to economic hardship and the fear of losing income.¹³ Social distancing non-compliance among these

groups may be even higher in contexts that lack a strong social safety net or compensation for lost wages.²⁹

The current study has several strengths, most notably its broadly representative sample and measures of social and psychological antecedent risk factors. Limitations include that the sample is not necessarily representative of other areas of Switzerland or other countries. Furthermore, while the COVID-19-related measures in Switzerland are generally in line with global recommendations, there are important differences in policies and information which may influence non-compliance. For example, some countries and cities require face masks to be worn when going outside,³⁰ whereas this was not recommended in Switzerland. Non-compliance with certain measures may therefore vary by the specific public health campaigns and official recommendations in each region.

Overall, our findings suggest that young people are largely complying with COVID-19 public health measures in Zurich. Non-compliance was strongly associated with weaker feelings of moral obligation and low trust in authorities, but also with high antisocial potential. Public health campaigns can implement strategies that foster moral obligation and trust in authorities, or leverage trustworthy individuals in the community to disseminate information. Our results suggested that it is also important to implement strategies that address the factors related to antisocial potential such as self-control. This can be accomplished for example through self-monitoring or environmental restructuring (or “nudging”) to promote protective health habits and behaviors.²³

Contributors

ME, LS, DR, UH, and AM co-developed and co-led the study, AS, ME, LS, UH, DR, AM, and LB contributed to the design of the questionnaire, DR organized the data collection, AN conducted the analyses and wrote up the results, AN and LS drafted and wrote the manuscript, AS, LB, ME, LS, DR, UH, AM, and AN contributed to the interpretation of the data, and critically revised the manuscript for important intellectual content.

Declaration of interests

We declare no competing interests.

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Table 1. Descriptive statistics for weighted sample

Variables	N	Mean/%	Linearized SE	Min	Max
Outcome					
Overall COVID-19 compliance	737	2.47	0.07	0	13
Hygiene COVID-19 compliance	737	1.77	0.05	0	6
Social distancing COVID-19 compliance	737	0.71	0.04	0	7
Antecedent factors (ages 17 and 20)					
Social bonds and lifestyle					
Low parental involvement (age 17)	713	2.04	0.02	1	4
Low parental monitoring (age 17)	712	1.99	0.02	1.3	4
Low teacher-child bond (age 17)	673	1.85	0.02	1	4
Low school commitment (age 17)	673	4.57	0.02	1.6	6.2
Low social support (age 20)	736	1.75	0.03	1	4
Social exclusion (age 20)	670	1.49	0.02	1	3.8
Low generalized trust (age 20)	737	2.65	0.03	1	4
Active lifestyle (age 20)	736	2.32	0.02	1	4
Attitudes toward the law and police					
Legal cynicism (age 20)	737	2.07	0.02	1	4
Low police legitimacy (age 20)	734	2.38	0.03	1	4
Deviant peers and behavior					
Deviant peers (age 20)	654	0.01	0.04	-2.2	2.9
Deviant behavior (age 20)	736	1.39	0.06	0	9
Dispositional factors					
Low self-control (age 20)	737	2.03	0.02	1	3.8
Low self-efficacy (age 20)	737	2.12	0.02	1	4
Low guilt/shame (age 20)	737	2.08	0.02	1	4
Concurrent factors (age 22)					
Family member has conditions increasing risk	737	57%	0.02	0	1
Respondent has conditions increasing risk	737	12%	0.01	0	1
Most do not follow instructions	737	1.98	0.02	1	4
Low moral norms	737	2.22	0.04	1	7
COVID-19 moral disengagement	734	1.92	0.02	1	4
Low trust in government	737	2.29	0.03	1	4
Low information-seeking	737	3.34	0.05	1	5
Sociodemographic background					
Gender (1=male)	737	51%	0.02	0	1
SES quartiles (ref: Q1 low SES)					
Q2	720	24%	0.02	0	1

Q3	720	25%	0.02	0	1
Q4 (high SES)	720	21%	0.02	0	1
Migrant background (1=both parents born abroad)	727	50%	0.02	0	1
Education level (ref: Gymnasium [high])					
Secondary school A	724	44%	0.02	0	1
Secondary school B/C	724	28%	0.02	0	1
Special needs education	724	1%	0.00	0	1

Note. All estimates are computed accounting for sample weights. SE=standard error.

Table 2. Binomial GLM regression results for odds of reporting non-compliance with each public health recommendation

Behavior type	Public health recommendation	Non-compliance			OR (ref: female)	t-value	p
		Full sample	Female	Male			
Hygiene	Avoid touching face	35%	31%	39%	1.42	2.19	0.028
	Clean/disinfect mobile phone	53%	47%	59%	1.59	2.97	0.003
	Cough or sneeze into elbow/cloth	3%	1%	5%	4.07	2.66	0.008
	Use hand disinfectant	27%	23%	30%	1.45	2.20	0.028
	Wash hands after cough/sneeze	53%	47%	58%	1.59	2.97	0.003
	Wash hands regularly	5%	4%	7%	1.82	1.78	0.075
Social distancing	Adhere to social distancing	18%	18%	18%	1.00	0.02	0.987
	Avoid contact with people at risk	5%	5%	5%	1.05	0.14	0.891
	Avoid groups	10%	5%	14%	2.90	3.77	<0.001
	Don't shake hands	12%	7%	16%	2.63	3.85	<0.001
	Only necessary public transport	10%	8%	12%	1.53	1.65	0.098
	Stay at home	13%	7%	19%	3.00	4.62	<0.001
	Stay at home with symptoms	3%	2%	4%	1.97	1.35	0.177

Note. All estimates are computed accounting for sample weights. OR=odds ratios.

Table 3. Adjusted binomial GLM regression results for odds of an additional non-compliance behavior by sociodemographic characteristics

	Hygiene non-compliance					Social distancing non-compliance					Overall non-compliance				
	OR	95%CIL	95%CIU	p		OR	95%CIL	95%CIU	p		OR	95%CIL	95%CIU	p	
Education level (age 15)															
Gymnasium (high)	ref.					ref.					ref.				
Secondary school A	0.76	0.64	—	0.91	<0.001	1.42	0.98	—	2.05	0.060	0.92	0.78	—	1.09	0.330
Secondary school B/C	0.63	0.49	—	0.82	<0.001	1.93	1.26	—	2.98	<0.001	0.92	0.74	—	1.16	0.490
Special needs education	0.86	0.35	—	2.14	0.750	1.45	0.34	—	6.21	0.620	1	0.39	—	2.57	1.000
Sex															
Female	ref.					ref.					ref.				
Male	1.36	1.16	—	1.6	<0.001	1.73	1.33	—	2.24	<0.001	1.43	1.25	—	1.64	<0.001
SES quartiles															
Q1 (low)	ref.					ref.					ref.				
Q2	1.13	0.87	—	1.47	0.360	1.24	0.83	—	1.84	0.290	1.16	0.92	—	1.47	0.210
Q3	1.16	0.87	—	1.53	0.310	0.99	0.63	—	1.55	0.960	1.1	0.86	—	1.41	0.450
Q4 (high)	1.63	1.23	—	2.18	<0.001	1.15	0.72	—	1.84	0.570	1.41	1.09	—	1.83	0.010
Migrant background															
At least one parent born in Switzerland	ref.					ref.					ref.				
Both parents born abroad	0.75	0.62	—	0.91	<0.001	0.94	0.68	—	1.3	0.710	0.83	0.69	—	0.98	0.030

note. All estimates are computed accounting for sample weights. Estimates are adjusted for sociodemographic characteristics. OR=odds ratio.

Figure 1. Adjusted odds ratios and 95% confidence intervals for antecedent and concurrent risk factors for overall non-compliance at age 22

Note. All analyses are conducted on weighted sample; adjusted effects are estimated controlling for sex, SES, education level, and migrant background.

Figure 2. Adjusted odds ratios and 95% confidence intervals for antecedent and concurrent risk factors for hygiene and social distancing non-compliance at age 22

Note. All analyses are conducted on weighted sample; adjusted effects are estimated controlling for sex, SES, education level, and migrant background.

ONLINE SUPPLEMENTARY MATERIAL
Nivette et al. Non-compliance with COVID-19-related public health measures among
young adults: Insights from a longitudinal cohort study
***Preprint materials: 2 May 2020**

Supplementary Appendix A: Information on sample weighting

The analysis of participation showed significantly higher response rates in women compared to men, and in (local) German speakers compared to other linguistic backgrounds (which serves as a proxy indicator for migrant background). We therefore created weights based on these respondent characteristics, which were available for the entire target sample of the initial z-proso study (i.e. including non-participants). Specifically, three groups were differentiated for each gender, in which one group had young people from German speaking backgrounds with the highest participation rate (55.2%), one group of young people from linguistic or cultural backgrounds with intermediate participation rate (49%, including English, Italian, Tamil, Turkish, and “other languages”), and one group of young people from backgrounds with low participation rates (34.4%, including Albanian, Serbo-Croatian, Spanish, Portuguese). Group size ranged from 71 cases to 197 cases, and weighting factors from 0.719 to 1.791. Information on weights for specific groups is available in the online supplement. The application of weights to the current sample means the results are comparable to the initial target sample, which is broadly representative of the age cohort in Zurich.

Supplementary Table 1. Information on weight for respondent characteristic groups

Group	N target sample	N COVID-19 sample	Participation rate	Weight	Weighted N
1 Male high participation	357	167	46.8%	1.003	168
2 Male mid participation	242	90	37.2%	1.262	114
3 Male low participation	271	71	26.2%	1.791	127
4 Female high participation	302	197	65.2%	0.719	142
5 Female mid participation	254	153	60.2%	0.779	119
6 Female low participation	249	108	43.4%	1.082	117
Total	1675	786	46.9%		786

Supplementary Appendix B: Information on sociodemographic characteristics, antecedent and concurrent variables used in the analyses

Sociodemographic characteristics

Sex was coded 0 for females and 1 for males. Socioeconomic status [SES] was measured based on the primary caregiver's occupation when the respondent was 15 years old or younger. Codes were transformed into an International Socioeconomic Index of occupational status (ISEI) score.¹ The respondent's SES score was based on the highest ISEI recorded for each household, and was divided into quartiles for analysis. The respondent's educational track level was measured at age 15. Respondents who were in Gymnasium (highest, college-track level) were the reference group (coded 0), compared to lower level education groups: secondary school A (higher non-college track, typically leading to "white collar" apprenticeships), secondary school B/C (lower non-college track, typically leading to "blue collar" apprenticeships), and special needs education, respectively. Migrant background was coded 0 for respondents with at least one parent born in Switzerland, and 1 for those with both parents born abroad.

Antecedent variables

Weak social bonds and active lifestyle. Strong bonds may reflect an individual's embeddedness in social networks and consequently exposure to social pressure to comply. We used eight variables to measure elements of weak social bonds and active social lifestyle: low parental involvement, low parental monitoring, low teacher-student bonds, low school commitment, low social support, social exclusion, low generalized trust, and social leisure activities. Parent- and school-related variables were measured at age 17, whereas exclusion, trust, and leisure activities were measured at age 20. Low parental involvement is a proxy for family bonds consisting of six items measuring how often an adolescent's parents talked, comforted, and showed interest in them. Low parental monitoring consisted of seven items capturing aspects of parental supervision and control. The low teacher-student bond scale consisted of three items measuring the quality of the adolescent's relationship with their current teacher. School commitment was a four-item scale that reflects a more general measure of an adolescent's bond to school. A four-item low social support scale was included to capture the respondent's access to trustworthy social ties for problem-solving and support. Social exclusion was a proxy for an individual's bonds to society. The scale consisted of six items measuring feelings of segregation, alienation, isolation, and worthlessness. The low generalized trust scale consisted of three items capturing feelings that people can be trusted and try to help people. An active social lifestyle may increase the risk of non-compliance, as individuals are motivated to maintain this lifestyle by e.g. leaving the home to engage in social gatherings. An individual's active social lifestyle was measured using 17 items that capture structured and unstructured routine activities outside the home, including meeting friends and practicing sports.

Attitudes towards the law and police. We used two measures that capture attitudes towards the law and police can be indicative of an individual's broader willingness to accept and comply with formal authorities and directives: low police legitimacy and legal cynicism. Low police legitimacy was measured using three items that reflect dimensions of police performance, fairness, and confidence in police effectiveness. Legal cynicism reflects the belief that the law is not binding. The legal cynicism scale consisted of six items that capture justifications for acting outside the law.

Deviant peers and antisocial behavior. In order to capture the influence of delinquent peers, respondents were asked about the delinquent behavior of their two 'best friends' (e.g. kick/hit and injure somebody, steal something from a shop, take illegal drugs). For each respondent, the mean score of the six items was constructed based on one or both best friends. Respondents who reported they did not have a best friend were treated as missing (n=26, 3.5%). The range was 0 to 1, so the variable was z-transformed to ease interpretation. A one-unit increase therefore reflects a one-standard deviation increase in deviant peer behavior. Prior antisocial behavior measured using a composite score of the respondent's involvement in 16 different antisocial behaviors in the year prior to the survey (i.e. between ages 19 and 20). Antisocial behaviors include bullying, truancy, substance use, theft, and violence.

Dispositional factors. We included three dispositional factors, low self-control, low self-efficacy, and low guilt/shame, as important predictors of health and risk behaviors. Low self-control was measured using 10 items including five sub-dimensions of self-control (i.e. impulsivity, self-centeredness, risk-seeking, preference for physical activities, and short temper). The low self-efficacy scale consisted of five items that reflect an individual's feelings of control and confidence in achieving goals. Low feelings of shame or guilt were captured using three items that ask respondents to what extent they feel bad or guilty when they have done wrong.

Concurrent variables

Two items were used to measure risk of infection. The respondents were asked whether they or a family member had a pre-existing condition that increases their risk or seriousness of infection. The respondent's attitudes about broader social non-compliance (i.e. social norms) were measured using a single item that capture perceptions about others' behavior during the outbreak. Moral norms were measured using four items that indicate whether the respondent believes certain non-compliant behaviors are wrong. The four-item COVID-19 moral disengagement reflected attitudes that underestimate or dismiss the risk of infection. The trust in government scale consisted of three items capturing the respondent's views on Swiss authorities in relation to the outbreak. Finally, information-seeking was measured by a single item that asks respondents how often he/she sought out news or information about COVID-19 in the two weeks prior to the survey.

All scales were constructed by taking the mean of the respective items. Reliability statistics are reported in Supplementary Table 2. A Cronbach's alpha $>.70$ is considered acceptable.

References

- 1 Ganzeboom, H, de Graaf P, Treiman D. A Standard International Socio-economic Index of Occupational Status. Soc Sci Res 1992; 21:1-56.

Supplementary Table 2. Information on the scales used in the analyses.

Antecedent factors (ages 17 and 20)	N items	Cronbach's alpha	Item examples
Social bonds and lifestyle			
Low parental involvement (age 17)	6	0.77	e.g. Your parents talk with you about your friends or your classmates; When you have problems, you can go to your parents
Low parental monitoring (age 17)	7	0.66	e.g. When you go out in your free time, your parents tell you when to come home; You have to tell your parents whom you meet with in your free time
Low teacher-student bond (age 17)	3	0.78	e.g. My teacher treats me fairly; I have a good relationship with my teacher
Low school commitment (age 17)	4	0.64	e.g. I like to go to school; I like to do my homework
Low social support (age 20)	4	0.80	e.g. There are adults I can talk to about my problems; I discuss my problems with adults
Social exclusion (age 20)	6	0.88	e.g. I have the feeling that I'm not really part of society; I don't have a chance in this society whatsoever
Low generalized trust (age 20)	3	0.84	e.g. Most people can be trusted; people usually try to help other people
Active social lifestyle (age 20)	17	0.68	e.g. How often...go out shopping with friends; practice sports in a club; participate in youth group
Attitudes toward the law and police			
Legal cynicism (age 20)	6	0.77	e.g. It is okay to do anything you want as long as you don't hurt anyone; Laws were made to be broken
Low police legitimacy (age 20)	3	0.83	e.g. The police treat people with dignity and respect; I'm confident that the police can do their job well
Deviant peers and behavior			
Deviant peers (age 20)	6 (per friend)	--	Whether the best friend e.g. kick/hit and injure somebody; steal something from a shop; take illegal drugs
Deviant behavior (age 20)	16	--	e.g. bullying, truancy, substance use, theft, violence
Dispositional factors			
Low self-control (age 20)	10	0.73	e.g. I often act on the spur of the moment without stopping to think; If things I do upset people, it's their problem not mine
Low self-efficacy (age 20)	5	0.74	e.g. I always know what to do in unexpected circumstances; I'm good at realizing my aims and intentions
Low guilt/shame (age 20)	3	0.69	e.g. I always feel guilty after I've done something wrong; when I lie, I feel ashamed because of it afterwards
Concurrent factors (age 22)			
Family member has conditions increasing risk	1	--	A family member...has a pre-existing condition that puts her at particular risk during the corona outbreak

Respondent has conditions increasing risk	1	--	I myself...have a previous illness which exposes me to a particular risk during the corona outbreak
Most do not follow instructions	1	--	Most people try to follow the instructions to combat the coronavirus
Low moral norms	4	0.75	Please indicate whether you think find it bad, rather not bad, rather bad, or very bad when people your age...e.g. meet other people and don't keep enough distance; do not self-isolate even though he/she feels sick
COVID-19 moral disengagement	4	0.63	e.g. Why should I follow the rules of social distancing? Others don't either; When older people get infected, it's their fault
Low trust in government	3	0.75	e.g. The measures taken by the Swiss authorities to deal with the corona crisis are effective; I agree with the measures taken by the Swiss authorities to combat the coronavirus
Low information-seeking	1	--	How often have you got any news or information about the corona virus over the past two weeks?

Supplementary Appendix C: Odds ratios, 95% confidence intervals, and p-values for unadjusted and adjusted risk factors of COVID-19 non-compliance

Supplementary Table 3. Unadjusted binomial GLM regression results for odds of an additional non-compliance behavior by sociodemographic characteristics

	Hygiene non-compliance					Social distancing non-compliance					Overall non-compliance				
	OR	95%CIL	95%CIU	p		OR	95%CIL	95%CIU	p		OR	95%CIL	95%CIU	p	
Education level (age 15)															
Gymnasium (high)	ref.					ref.					ref.				
Secondary school A	0.77	0.64	—	0.92	0.005	1.52	1.05	—	2.20	0.026	0.95	0.80	—	1.12	0.517
Secondary school B/C	0.63	0.49	—	0.81	<0.001	2.01	1.31	—	3.09	0.001	0.93	0.74	—	1.17	0.553
Special needs education	0.75	0.31	—	1.82	0.529	1.59	0.44	—	5.79	0.479	0.95	0.43	—	2.3	0.904
Sex															
Female	ref.					ref.					ref.				
Male	1.42	1.22	—	1.66	<0.001	1.73	1.34	—	2.23	0.000	1.47	1.29	—	1.69	<0.001
SES quartiles															
Q1 (low)	ref.					ref.					ref.				
Q2	1.09	0.84	—	1.42	0.510	1.24	0.85	—	1.82	0.268	1.14	0.90	—	1.44	0.265
Q3	1.17	0.88	—	1.54	0.282	1.11	0.72	—	1.72	0.630	1.15	0.89	—	1.47	0.287
Q4 (high)	1.60	1.2	—	2.12	0.001	1.19	0.74	—	1.90	0.474	1.41	1.09	—	1.83	0.009
Migrant background															
At least one parent born in Switzerland	ref.					ref.					ref.				
Both parents born abroad	0.75	0.62	—	0.90	0.003	0.96	0.70	—	1.31	0.780	0.83	0.70	—	0.98	0.030

Note. All estimates are computed accounting for sample weights. OR=odds ratio.

Supplementary Table 4. Unadjusted binomial GLM regression results for antecedent and concurrent risk factors of non-compliance behaviors

Antecedent factors	Overall non-compliance					Hygiene non-compliance					Social distancing non-compliance				
	OR	95%CIL	95%CIU	p		OR	95%CIL	95%CIU	p		OR	95%CIL	95%CIU	p	
Weak social bonds and lifestyle															
Low parental involvement (age 17)	1.10	0.99	—	1.23	0.081	1.05	0.92	—	1.19	0.467	1.23	1.02	—	1.50	0.035
Low parental monitoring (age 17)	1.28	1.12	—	1.48	<0.001	1.12	0.96	—	1.32	0.154	1.73	1.36	—	2.19	<0.001
Low teacher-student bond (age 17)	1.08	0.94	—	1.24	0.272	1.04	0.89	—	1.21	0.593	1.17	0.91	—	1.51	0.216
Low school commitment (age 17)	1.30	1.14	—	1.47	<0.001	1.37	1.18	—	1.59	<0.001	1.23	0.98	—	1.53	0.070
Low social support (age 20)	1.06	0.96	—	1.17	0.260	1.03	0.92	—	1.15	0.612	1.13	0.94	—	1.35	0.189
Social exclusion (age 20)	1.06	0.94	—	1.20	0.308	1.07	0.93	—	1.22	0.341	1.07	0.85	—	1.34	0.585
Low generalized trust (age 20)	0.92	0.82	—	1.03	0.144	0.75	0.66	—	0.84	<0.001	1.34	1.08	—	1.67	0.008
Active social lifestyle (age 20)	1.06	0.90	—	1.25	0.508	0.95	0.79	—	1.15	0.608	1.31	0.98	—	1.76	0.072
Attitudes toward the law and police															
Legal cynicism (age 20)	1.30	1.15	—	1.47	<0.001	1.22	1.06	—	1.40	0.005	1.55	1.25	—	1.92	<0.001
Low police legitimacy (age 20)	1.13	1.01	—	1.26	0.027	1.03	0.92	—	1.15	0.649	1.38	1.14	—	1.68	0.001
Deviant peers and behavior															
Deviant peers (age 20)	1.21	1.12	—	1.31	<0.001	1.20	1.10	—	1.30	<0.001	1.28	1.10	—	1.50	0.002
Deviant behavior (age 20)	1.14	1.09	—	1.19	<0.001	1.15	1.09	—	1.21	<0.001	1.16	1.07	—	1.25	<0.001
Dispositional factors															
Low self-control (age 20)	1.39	1.18	—	1.64	<0.001	1.11	0.91	—	1.36	0.318	2.28	1.73	—	3.02	<0.001
Low self-efficacy (age 20)	0.80	0.67	—	0.95	0.010	0.84	0.70	—	1.02	0.085	0.68	0.49	—	0.96	0.027
Low guilt/shame (age 20)	1.26	1.12	—	1.41	<0.001	1.21	1.06	—	1.39	0.006	1.41	1.18	—	1.69	<0.001
Concurrent factors (age 22)															
Family pre-existing conditions	0.74	0.58	—	0.94	0.013	0.74	0.57	—	0.97	0.029	0.69	0.45	—	1.07	0.094
Respondent pre-existing conditions	0.82	0.71	—	0.94	0.005	0.88	0.75	—	1.04	0.140	0.67	0.51	—	0.87	0.003
Most do not follow instructions	0.97	0.86	—	1.09	0.556	0.84	0.74	—	0.96	0.011	1.25	1.03	—	1.51	0.026
Low moral norms	1.53	1.41	—	1.65	<0.001	1.33	1.22	—	1.45	<0.001	2.03	1.78	—	2.32	<0.001
COVID-19 moral disengagement	1.57	1.36	—	1.81	<0.001	1.15	0.97	—	1.35	0.100	3.00	2.41	—	3.74	<0.001
Low trust in government	1.19	1.04	—	1.35	0.010	0.91	0.79	—	1.04	0.174	1.97	1.62	—	2.41	<0.001
Low information-seeking	1.14	1.07	—	1.20	<0.001	1.13	1.07	—	1.20	<0.001	1.17	1.05	—	1.30	0.003

Notes. All analyses are conducted on weighted sample. OR=odds ratio; CIL= Confidence interval (lower); CIU = confidence interval (upper)

Supplementary Table 5. Adjusted binomial GLM regression results for antecedent and concurrent risk factors of non-compliance behaviors

Antecedent factors	Overall non-compliance					Hygiene non-compliance					Social distancing non-compliance				
	OR	95%CIL	95%CIU	p		OR	95%CIL	95%CIU	p		OR	95%CIL	95%CIU	p	
Weak social bonds and lifestyle															
Low parental involvement (age 17)	1.17	1.04	—	1.31	0.010	1.18	1.03	—	1.34	0.014	1.19	0.95	—	1.49	0.129
Low parental monitoring (age 17)	1.19	1.03	—	1.38	0.017	1.09	0.92	—	1.29	0.318	1.47	1.13	—	1.89	0.003
Low teacher-student bond (age 17)	1.06	0.92	—	1.21	0.444	0.98	0.85	—	1.14	0.841	1.23	0.95	—	1.60	0.121
Low school commitment (age 17)	1.11	0.97	—	1.26	0.139	1.08	0.93	—	1.26	0.297	1.19	0.93	—	1.52	0.161
Low social support (age 20)	1.10	0.99	—	1.23	0.069	1.12	1.00	—	1.27	0.055	1.10	0.90	—	1.34	0.364
Social exclusion (age 20)	1.09	0.97	—	1.22	0.159	1.10	0.96	—	1.25	0.167	1.09	0.87	—	1.36	0.470
Low generalized trust (age 20)	1.03	0.93	—	1.15	0.544	0.90	0.80	—	1.01	0.074	1.37	1.12	—	1.68	0.002
Active social lifestyle (age 20)	1.04	0.88	—	1.22	0.648	0.90	0.74	—	1.08	0.256	1.34	1.00	—	1.80	0.047
Attitudes toward the law and police															
Legal cynicism (age 20)	1.27	1.13	—	1.42	<0.001	1.20	1.05	—	1.38	0.009	1.46	1.18	—	1.80	0.001
Low police legitimacy (age 20)	1.15	1.04	—	1.28	0.008	1.05	0.93	—	1.18	0.408	1.40	1.17	—	1.68	<0.001
Deviant peers and behavior															
Deviant peers (age 20)	1.16	1.08	—	1.25	<0.001	1.11	1.02	—	1.20	0.019	1.33	1.15	—	1.54	<0.001
Deviant behavior (age 20)	1.10	1.05	—	1.15	<0.001	1.09	1.03	—	1.15	0.002	1.15	1.06	—	1.25	<0.001
Dispositional factors															
Low self-control (age 20)	1.38	1.18	—	1.61	<0.001	1.16	0.96	—	1.40	0.130	2.03	1.54	—	2.69	<0.001
Low self-efficacy (age 20)	0.85	0.73	—	1.00	0.057	0.89	0.75	—	1.07	0.216	0.77	0.55	—	1.07	0.114
Low guilt/shame (age 20)	1.19	1.06	—	1.34	0.003	1.20	1.05	—	1.38	0.010	1.23	1.01	—	1.50	0.035
Concurrent factors (age 22)															
Family pre-existing conditions	0.83	0.64	—	1.06	0.130	0.85	0.64	—	1.12	0.496	0.75	0.48	—	1.17	0.205
Respondent pre-existing conditions	0.88	0.76	—	1.01	0.070	0.95	0.80	—	1.11	0.245	0.74	0.56	—	0.97	0.027
Most do not follow instructions	1.04	0.92	—	1.16	0.563	0.95	0.83	—	1.09	0.478	1.22	0.99	—	1.50	0.062
Low moral norms	1.48	1.36	—	1.60	<0.001	1.30	1.19	—	1.41	<0.001	1.99	1.75	—	2.27	<0.001
COVID-19 moral disengagement	1.82	1.59	—	2.09	<0.001	1.46	1.23	—	1.72	<0.001	3.04	2.43	—	3.81	<0.001
Low trust in government	1.26	1.12	—	1.42	<0.001	1.03	0.89	—	1.18	0.717	1.90	1.57	—	2.32	<0.001
Low information-seeking	1.13	1.07	—	1.19	<0.001	1.10	1.04	—	1.17	0.002	1.21	1.09	—	1.34	<0.001

Notes. All analyses were conducted on weighted sample; partial effects were estimated controlling for gender, SES, education level, and migrant background. OR=odds ratio; CIL=Confidence interval (lower); CIU = confidence interval (upper)

Supplementary Appendix D: Results for analyses using imputed data

Supplementary Table 6. Binomial GLM regression results on imputed data for odds of reporting non-compliance with each public health recommendation

Behavior type	Public health recommendation	Non-compliance			OR (ref: female)	t-value	p
		Full sample	Female	Male			
Hygiene	Avoid touching face	35%	31%	39%	1.42	2.19	0.028
	Clean/disinfect mobile phone	53%	47%	59%	1.59	2.97	0.003
	Cough or sneeze into elbow/cloth	3%	1%	5%	4.07	2.66	0.008
	Use hand disinfectant	27%	23%	30%	1.45	2.20	0.028
	Wash hands after cough/sneeze	53%	47%	58%	1.59	2.97	0.003
	Wash hands regularly	5%	4%	7%	1.82	1.78	0.075
Social distancing	Adhere to social distancing	18%	18%	18%	1.00	0.02	0.987
	Avoid contact with people at risk	5%	5%	5%	1.05	0.14	0.891
	Avoid groups	10%	5%	14%	2.90	3.77	<0.001
	Don't shake hands	12%	7%	16%	2.63	3.85	<0.001
	Only necessary public transport	10%	8%	12%	1.53	1.65	0.098
	Stay at home	13%	7%	19%	3.00	4.62	<0.001
	Stay at home with symptoms	3%	2%	4%	1.97	1.35	0.177

Note. Multiple imputation with chained equations was used to compute 10 complete datasets (n=737). Results are based on imputed data and accounting for population weights.

Supplementary Table 7. Unadjusted binomial GLM regression results on imputed data for odds of an additional non-compliance behavior by sociodemographic characteristics

	Hygiene non-compliance					Social distancing non-compliance					Overall non-compliance				
	OR	95%CIL	95%CIU	p		OR	95%CIL	95%CIU	p		OR	95%CIL	95%CIU	p	
Education level (age 15)															
Gymnasium (high)	ref.					ref.					ref.				
Secondary school A	0.65	0.55	—	0.78	<0.001	1.51	1.08	—	2.11	0.015	0.85	0.73	—	0.99	0.042
Secondary school B/C	0.45	0.36	—	0.56	<0.001	1.89	1.32	—	2.69	<0.001	0.74	0.62	—	0.89	0.002
Special needs education	0.64	0.26	—	1.57	0.329	1.54	0.43	—	5.47	0.505	0.86	0.34	—	2.07	0.713
Sex															
Female	ref.					ref.					ref.				
Male	1.43	1.22	—	1.68	<0.001	1.78	1.38	—	2.28	<0.001	1.5	1.31	—	1.72	<0.001
SES quartiles															
Q1 (low)	ref.					ref.					ref.				
Q2	1.31	1.02	—	1.69	0.036	1.12	0.78	—	1.62	0.540	1.23	0.98	—	1.54	0.074
Q3	1.61	1.28	—	2.04	<0.001	0.88	0.61	—	1.28	0.511	1.29	1.05	—	1.59	0.016
Q4 (high)	2.46	1.97	—	3.09	<0.001	0.9	0.62	—	1.3	0.570	1.69	1.4	—	2.05	<0.001
Migrant background															
At least one parent born in Switzerland	ref.					ref.					ref.				
Both parents born abroad	0.58	0.49	—	0.69	<0.001	1.06	0.82	—	1.39	0.641	0.73	0.63	—	0.84	<0.001

Note. Multiple imputation with chained equations was used to compute 10 complete datasets (n=737). Results are based on imputed data and accounting for sample weights. OR=odds ratio; CIL= Confidence interval (lower); CIU = confidence interval (upper)

Supplementary Table 8. Adjusted binomial GLM regression results on imputed data for odds of an additional non-compliance behavior by sociodemographic characteristics

	Hygiene non-compliance					Social distancing non-compliance					Overall non-compliance				
	OR	95%CIL	95%CIU	p		OR	95%CIL	95%CIU	p		OR	95%CIL	95%CIU	p	
Education level (age 15)															
Gymnasium (high)	ref.					ref.					ref.				
Secondary school A	0.77	0.64	—	0.92	0.005	1.52	1.05	—	2.2	0.026	0.95	0.8	—	1.12	0.517
Secondary school B/C	0.63	0.49	—	0.81	<0.001	2.01	1.31	—	3.09	0.001	0.93	0.74	—	1.17	0.553
Special needs education	0.75	0.31	—	1.82	0.529	1.59	0.44	—	5.79	0.479	0.95	0.43	—	2.3	0.904
Sex															
Female	ref.					ref.					ref.				
Male	1.42	1.22	—	1.66	<0.001	1.73	1.34	—	2.23	<0.001	1.47	1.29	—	1.69	<0.001
SES quartiles															
Q1 (low)	ref.					ref.					ref.				
Q2	1.09	0.84	—	1.42	0.510	1.24	0.85	—	1.82	0.268	1.14	0.9	—	1.44	0.265
Q3	1.17	0.88	—	1.54	0.282	1.11	0.72	—	1.72	0.630	1.15	0.89	—	1.47	0.287
Q4 (high)	1.6	1.2	—	2.12	0.001	1.19	0.74	—	1.9	0.474	1.41	1.09	—	1.83	0.009
Migrant background															
At least one parent born in Switzerland	ref.					ref.					ref.				
Both parents born abroad	0.75	0.62	—	0.9	0.003	0.96	0.7	—	1.31	0.780	0.83	0.7	—	0.98	0.030

Note. Multiple imputation with chained equations was used to compute 10 complete datasets (n=737). Results are based on imputed data and accounting for sample weights. Estimates are adjusted for sociodemographic characteristics. OR=odds ratio; CIL= Confidence interval (lower); CIU = confidence interval (upper)

Supplementary Table 9. Unadjusted binomial GLM regression results on imputed data for antecedent and concurrent risk factors of non-compliance behaviors

Antecedent factors	Overall non-compliance					Hygiene non-compliance					Social distancing non-compliance				
	OR	95% CIL	95% CIU	p		OR	95% CIL	95% CIU	p		OR	95% CIL	95% CIU	p	
Weak social bonds and lifestyle															
Low parental involvement (age 17)	1.11	0.99	—	1.23	0.068	1.06	0.93	—	1.20	0.364	1.22	1.01	—	1.49	0.042
Low parental monitoring (age 17)	1.28	1.12	—	1.48	<0.001	1.14	0.97	—	1.33	0.122	1.70	1.34	—	2.16	<0.001
Low teacher-student bond (age 17)	1.09	0.95	—	1.24	0.208	1.06	0.91	—	1.22	0.484	1.18	0.92	—	1.51	0.202
Low school commitment (age 17)	1.31	1.15	—	1.49	<0.001	1.38	1.19	—	1.60	<0.001	1.24	0.99	—	1.55	0.057
Low social support (age 20)	1.06	0.96	—	1.17	0.255	1.03	0.92	—	1.15	0.619	1.13	0.94	—	1.36	0.193
Social exclusion (age 20)	1.07	0.95	—	1.20	0.278	1.07	0.94	—	1.23	0.304	1.07	0.85	—	1.34	0.562
Low generalized trust (age 20)	0.92	0.82	—	1.03	0.144	0.75	0.66	—	0.84	<0.001	1.34	1.08	—	1.67	0.008
Active social lifestyle (age 20)	1.06	0.90	—	1.25	0.511	0.95	0.79	—	1.15	0.607	1.31	0.98	—	1.76	0.072
Attitudes toward the law and police															
Legal cynicism (age 20)	1.30	1.15	—	1.47	<0.001	1.22	1.06	—	1.40	0.005	1.55	1.25	—	1.92	<0.001
Low police legitimacy (age 20)	1.13	1.02	—	1.26	0.025	1.03	0.92	—	1.15	0.628	1.39	1.14	—	1.68	0.001
Deviant peers and behavior															
Deviant peers (age 20)	1.22	1.13	—	1.31	<0.001	1.20	1.11	—	1.31	<0.001	1.30	1.12	—	1.50	0.001
Deviant behavior (age 20)	1.14	1.09	—	1.19	<0.001	1.15	1.09	—	1.21	<0.001	1.17	1.08	—	1.26	<0.001
Dispositional factors															
Low self-control (age 20)	1.39	1.18	—	1.64	<0.000	1.11	0.91	—	1.36	0.318	2.28	1.73	—	3.02	<0.001
Low self-efficacy (age 20)	0.80	0.67	—	0.95	0.010	0.84	0.70	—	1.02	0.085	0.68	0.49	—	0.96	0.027
Low guilt/shame (age 20)	1.26	1.12	—	1.41	<0.000	1.21	1.06	—	1.39	0.006	1.41	1.18	—	1.69	<0.001
Concurrent factors (age 22)															
Family pre-existing conditions	0.74	0.58	—	0.94	0.013	0.74	0.57	—	0.97	0.029	0.69	0.45	—	1.07	0.094
Respondent pre-existing conditions	0.82	0.71	—	0.94	0.005	0.88	0.75	—	1.04	0.140	0.67	0.51	—	0.87	0.003
Most do not follow instructions	0.97	0.86	—	1.09	0.556	0.84	0.74	—	0.96	0.011	1.25	1.03	—	1.51	0.026
Low moral norms	1.53	1.41	—	1.65	<0.000	1.33	1.22	—	1.45	<0.001	2.03	1.78	—	2.32	<0.001
COVID-19 moral disengagement	1.57	1.35	—	1.81	<0.001	1.15	0.97	—	1.35	0.099	3.00	2.41	—	3.73	<0.001
Low trust in government	1.19	1.04	—	1.35	0.010	0.91	0.79	—	1.04	0.174	1.97	1.62	—	2.41	<0.001
Low information-seeking	1.14	1.07	—	1.20	<0.001	1.13	1.07	—	1.20	0.000	1.17	1.05	—	1.30	0.003

Notes. Multiple imputation with chained equations was used to compute 10 complete datasets (n=737). Results are based on imputed data and accounting for sample weights. OR=odds ratio; CIL= Confidence interval (lower); CIU = confidence interval (upper)

Supplementary Table 10. Adjusted binomial GLM regression results on imputed data for antecedent and concurrent risk factors of non-compliance behaviors

Antecedent factors	Overall non-compliance					Hygiene non-compliance					Social distancing non-compliance				
	OR	95% CIL	95% CIU	p		OR	95% CIL	95% CIU	p		OR	95% CIL	95% CIU	p	
Weak social bonds and lifestyle															
Low parental involvement (age 17)	1.19	1.06	—	1.32	0.003	1.22	1.07	—	1.39	0.002	1.17	0.95	—	1.43	0.148
Low parental monitoring (age 17)	1.22	1.06	—	1.40	0.005	1.13	0.96	—	1.33	0.135	1.47	1.15	—	1.87	0.002
Low teacher-student bond (age 17)	1.05	0.92	—	1.20	0.498	1.00	0.86	—	1.15	0.967	1.16	0.91	—	1.49	0.231
Low school commitment (age 17)	1.46	1.00	—	1.31	0.046	1.12	0.96	—	1.30	0.137	1.24	0.98	—	1.57	0.076
Low social support (age 20)	1.11	1.00	—	1.23	0.040	1.12	1.00	—	1.26	0.049	1.13	0.93	—	1.36	0.222
Social exclusion (age 20)	1.09	0.97	—	1.22	0.134	1.10	0.97	—	1.25	0.150	1.09	0.88	—	1.35	0.424
Low generalized trust (age 20)	1.01	0.89	—	1.12	0.931	0.88	0.78	—	0.99	0.034	1.30	1.04	—	1.61	0.021
Active social lifestyle (age 20)	1.01	0.86	—	1.18	0.937	0.87	0.72	—	1.06	0.160	1.28	0.97	—	1.69	0.085
Attitudes toward the law and police															
Legal cynicism (age 20)	1.26	1.12	—	1.41	<0.001	1.21	1.05	—	1.38	0.007	1.40	1.14	—	1.73	0.002
Low police legitimacy (age 20)	1.13	1.02	—	1.26	0.024	1.04	0.93	—	1.17	0.488	1.34	1.11	—	1.62	<0.001
Deviant peers and behavior															
Deviant peers (age 20)	1.16	1.07	—	1.25	<0.001	1.10	1.02	—	1.20	0.016	1.31	1.13	—	1.52	<0.001
Deviant behavior (age 20)	1.10	1.05	—	1.15	<0.001	1.09	1.03	—	1.14	0.002	1.15	1.06	—	1.24	<0.001
Dispositional factors															
Low self-control (age 20)	1.38	1.18	—	1.61	<0.001	1.16	0.96	—	1.40	0.124	2.03	1.54	—	2.67	<0.001
Low self-efficacy (age 20)	0.84	0.72	—	0.99	0.043	0.89	0.75	—	1.07	0.218	0.74	0.53	—	1.02	0.069
Low guilt/shame (age 20)	1.19	1.06	—	1.34	0.003	1.19	1.04	—	1.36	0.011	1.24	1.03	—	1.50	0.026
Concurrent factors (age 22)															
Family pre-existing conditions	0.79	0.62	—	1.01	0.058	0.82	0.63	—	1.07	0.142	0.71	0.47	—	1.09	0.119
Respondent pre-existing conditions	0.85	0.74	—	0.98	0.025	0.93	0.79	—	1.08	0.245	0.70	0.54	—	0.91	0.009
Most do not follow instructions	1.03	0.92	—	1.15	0.636	0.95	0.84	—	1.07	0.406	1.20	0.98	—	1.47	0.072
Low moral norms	1.49	1.37	—	1.62	<0.001	1.30	1.19	—	1.41	<0.001	2.02	1.78	—	2.29	<0.001
COVID-19 moral disengagement	1.79	1.56	—	2.07	<0.001	1.44	1.22	—	1.69	<0.001	2.93	2.32	—	3.67	<0.001
Low trust in government	1.28	1.12	—	1.45	<0.001	1.04	0.91	—	1.20	0.560	1.91	1.56	—	2.34	<0.001
Low information-seeking	1.12	1.06	—	1.19	<0.001	1.10	1.04	—	1.17	0.001	1.19	1.07	—	1.32	0.001

Notes. Multiple imputation with chained equations was used to compute 10 complete datasets (n=737). Results are based on imputed data and accounting for sample weights. partial effects are estimated controlling for gender, SES, education level, and migrant background. OR=odds ratio; CIL= Confidence interval (lower); CIU = confidence interval (upper)