Research report

Did Smoking, Alcohol Consumption, and Physical Activity Change during the COVID-19 Restrictions in Germany in Spring 2020?

Findings from a Cross-Sectional Population Survey (the DEBRA Study)

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Abstract: *Aims:* Nationwide restrictions were implemented in Germany in March 2020 to reduce the spread of the severe acute respiratory syndrome coronavirus type 2 (SARS-COV-2). It is not yet precisely known how these restrictions affected peoples' health behaviours in Germany. Objectives were to 1) retrospectively examine changes in self-reported health behaviours (tobacco smoking, alcohol consumption, and physical activity) in response to these restrictions; and 2) to explore associations among health behaviour changes as well as links to socioeconomic and sociodemographic characteristics. *Methodology:* We used data from two waves (June-August 2020) of the German Study on Tobacco Use (DEBRA): a cross-sectional, representative survey with people aged ≥14 years (n=4078). Associations between socioeconomic and sociodemographic characteristics and health behaviour changes were analysed using multinomial logistic regression analyses. *Results:* Changes in health behaviours were as follows: smoking increase=24.0 % (95 % confidence interval (CI)=21.5–26.7), decrease=12.2 % (95 %CI=10.4–14.4); alcohol consumption increase=12.9 % (95 %CI=11.7–14.1), decrease=19.9 % (95 %CI=18.4–21.3); physical activity increase=18.5 % (95 %CI=17.3–19.7); decrease=29.4 % (95 %CI=28.0–31.0). Younger people with a lower level of education were more likely to report a harmful health behaviour change. *Conclusions:* The majority of people did not change their health behaviours. Among those who did, comparatively more increased their smoking and decreased their alcohol consumption and physical activity. Public health interventions in this context should particularly target younger people and those with a lower level of education.

Keywords: COVID-19, health behaviour, physical activity, tobacco smoking, alcohol consumption, lockdown

Haben sich die selbstberichteten Angaben zum Tabakrauchen, Alkoholkonsum und der körperlichen Bewegung während der COVID-19-Restriktionen im Frühjahr 2020 in Deutschland verändert? Erkenntnisse aus einer populationsbezogenen Querschnittserhebung (DEBRA Studie)

Zusammenfassung: *Zielsetzung:* Im März 2020 wurden in Deutschland flächendeckende Beschränkungen eingeführt, um die Ausbreitung des schweren akuten respiratorischen Syndroms Coronavirus Typ 2 einzudämmen. Es ist unklar, wie sich diese Beschränkungen auf das Gesundheitsverhalten der Menschen auswirkten. Ziel dieser Arbeit war es, rückblickend von den Befragten wahrgenommene Veränderungen in Bezug auf ihr Tabakrauchen, ihren Alkoholkonsum und ihre körperliche Aktivität im Vergleich zu der Zeit vor den Beschränkungen zu untersuchen und Zusammenhänge zwischen möglichen Veränderungen und sozioökonomischen und soziodemografischen Merkmalen zu erforschen. *Methodik:* Datenbasis war die Deutsche Befragung zum Rauchverhalten (DEBRA), eine repräsentative Querschnittserhebung bei Personen ab 14 Jahren. Analysiert wurden Daten aus 2 Wellen (Juni-August 2020) von 4.078 Teilnehmenden. Zusammenhänge zwischen sozioökonomischen und soziodemografischen Merkmalen und Veränderungen in den einzelnen Gesundheitsverhaltensweisen wurden mithilfe multinomialer logistischer Regressionsanalysen analysiert. *Ergebnisse:* Veränderungen im Gesundheitsverhalten: Zunahme im Rauchverhalten=24,0 % (95 % Konfidenzintervall (KI)=21,5–26,7), Abnahme=12,2 % (95 %KI=10,4–14,4); Zunahme des Alkoholkonsums=12,9 % (95 %KI=11,7–14,1), Abnahme=19,9 % (95 %KI=18,4–21,3); Zunahme des Bewegungsverhaltens=18,5 % (95 %KI=17,3–19,7), Abnahme=29,4 % (95 %KI=28,0–31,0). Personen mit einem niedrigeren Bildungsniveau und jüngerem Alter berichteten häufiger über eine schädliche Veränderung desGesundheitsverhaltens.

Schlussfolgerungen: Die meisten Menschen gaben keine Veränderung ihres Gesundheitsverhalten an. Von den Personen, die ihr Verhalten verändert haben, rauchten relativ mehr Tabak, und tranken weniger Alkohol bzw. bewegten sich weniger. Von diesen Veränderungen waren vor allem Personen mit einem niedrigeren Bildungsniveau und jüngeren Alters betroffen, was bei Präventivmaßnahmen berücksichtig werden sollte.

Schlüsselwörter: COVID-19, Gesundheitsverhalten, körperliche Bewegung, Tabakrauchen, Alkoholkonsum, Lockdown

Abbreviations

CI	Confidence interval
COVID-19	Coronavirus disease 2019
DEBRA	Deutsche Befragung zum Rauchverhalten
OR	Odds ratio

Introduction

At the end of January 2020, the severe acute respiratory syndrome coronavirus type 2 (SARS-CoV-2), reached Europe. By the beginning of March, cases of coronavirus disease 2019 infection (COVID-19) were reported in all 16 federal states of Germany (Robert Koch-Institut, 2020).

Like other European countries (e.g. Italy, Spain [ZDF heute, 2020]) Germany implemented nationwide restrictions of social life and contacts on March 22nd, aimed at reducing the spread of the virus (Destatis, 2020). Some service sectors had to close completely (e.g., restaurants, sports centres) and many employees were sent on short-time work (Destatis, 2020). There were also substantial restrictions within the health care system, and psychotherapy and psychosocial consultations had to switch to digital formats or were offered with reduced capacity, which affected the treatment of addictive disorders, including courses for smoking cessation or alcohol abstinence interventions (Blick.de, 2020).

The levels of physical activity might have changed as well since many sporting habits could not be pursued during this time e.g., due to closure of leisure centres and fitness studios (Jordan et al., 2020). However, some people might have had more time to pursue physical activity outdoors during this time.

Changes in health behaviours during these restrictions were reported from different countries. Whereas data from the United States, England, and Belgium indicate a substantial increase in alcohol consumption (Grossman, Benjamin-Neelon & Sonnesnchein, 2020; Naughton et al., 2021; Vanderbruggen et al., 2020), further data from England and Australia showed mixed results (Garnett et al., 2021; Stanton et al., 2020). Concerning tobacco consumption, findings are also mixed. While a study from Belgium (Vanderbruggen et al., 2020) found an increase in tobacco smoking, surveys from Australia and England reported no changes or even a strong reduction in smoking behaviours (Jackson, Garnett, Shahab, Oldham & Brown, 2020; Naughton et al., 2021; Siddiqi et al., 2020; Stanton et al., 2020).

A decrease in the level of physical activity has been observed in the majority of 66 articles (N = 86 981) included in a systematic review (Stockwell et al., 2021). A study from Belgium as well as further studies from Italy and England showed a reduction in moderate to vigorous physical activity, but an increase in strength training (Constandt et al., 2020; Di Renzo et al., 2020; Naughton et al., 2021). Indeed, the change in physical activity seems to be dependent on the age of the respondents, their physical activity behaviour prior to the restrictions and habits (Constandt et al., 2020).

Current evidence suggests that specific groups are more prone to health behaviour changes during the restrictions. These data can help to detect a worsening of the deprivation of people from more disadvantaged groups.

Therefore, this study aimed to retrospectively examine whether there was a change in self-reported health behaviours (tobacco smoking, alcohol consumption, and physical activity) in response to the first wave of the COVID-19 restrictions in Germany in spring 2020. Furthermore, this study also aimed to explore potential associations among changes in health behaviours, if any, and links to socioeconomic and sociodemographic characteristics.

Methodology

We used data from the German Study on Tobacco Use (DEBRA: "Deutsche Befragung zum Rauchverhalten", www.debra-study.info), an ongoing representative household survey (Kastaun et al., 2017). The DEBRA study collects bimonthly data by means of computer-assisted, face-to-face household interviews in a new sample of about 2000 peo-

ple aged 14+ each survey wave. Questions on health behaviour changes during the nationwide COVID-19 restrictions in spring 2020 (March 22nd to June 5th) were added to two waves of the DEBRA study: wave 24 (June/July 2020) and wave 25 (July/August 2020). For the present analysis, data on both waves were aggregated resulting in a total sample of 4078 respondents.

Sampling method and weighting

The COVID-19 pandemic substantially affected the possibility and willingness of the general public to participate in face-to-face household surveys, leading to lower response rates during the pandemic than before. As a consequence, the proportion of the quota sampling had to be increased up to 100 % during the study waves 24 and 25 to further balance expected non-response effects. Often not all quota requirements can be met. These shortfalls can be distributed disproportionately to the German population and thus lead to a bias in the sample. We applied a calibration weighting to correct for disproportions due to the structure of target persons who did or did not participate in the survey. The current micro census serves as the data basis for this calibration. Details on the weighting technique and changes in the sampling design of DEBRA have been published elsewhere: *https://osf.io/s2wxc/*.

This study was approved by the ethics committee of the Heinrich-Heine-University Duesseldorf (HHU 5386R) and was registered at the German Clinical Trials Register (DRKS00011322 and DRKS00017157).

Measurements

Measuring sociodemographic characteristics

We collected self-reported data on age, sex, education, and monthly net household income of respondents. The level of education was categorised into three groups: low (no qualification or junior high school equivalent ["Hauptschulabschluss"]), middle or secondary school equivalent ("Realschulabschluss"), and high level of education (advanced technical college equivalent ["Fachhochschulreife"]), or high school equivalent ("Allgemeine Hochschulreife"). In order to have the distribution of income in the German population reflected in our data in the best possible way, we assigned the monthly net income to the following categories: low = approximately <20th income percentile, middle = approximately 20th to 80th income percentiles, and high = approximately >80th income percentile (details: *https://osf.io/387fg/*).

Self-reported changes in health behaviour

Behaviour changes during the time of the first wave of COVID-19 restrictions in spring 2020 were collected for the three health behaviours of interest by using a 7-point Likert Scale, containing the following response categories:

Tobacco smoking: *"During the time of corona restrictions, I ...*

1. *smoked much more than before*
2. *smoked somewhat more than before*
3. *smoked the same amount than before*
4. *smoked somewhat less than before*
5. *smoked much less than before*
6. *don't smoke tobacco at all*
7. *no answer"*

Alcohol consumption: *"During the time of corona restrictions, I ...*

1. *drank much more alcohol than before*
2. *drank somewhat more alcohol than before*
3. *drank the same amount of alcohol than before*
4. *drank somewhat less alcohol than before*
5. *drank much less alcohol than before*
6. *I don't drink alcohol at all*
7. *no answer"*

Physical activity: *"During the time of corona restrictions, I was ...*

1. *much more active than before*
2. *somewhat more active than before*
3. *just as active as before*
4. *slightly less active than before*
5. *much less active than before*
6. *I can't move around*
7. *no answer"*

Answers were classified into "increase" (response options 1 and 2), "no change" (response option 3) and "decrease" (response options 4 and 5). People who reported that they do not smoke, drink or cannot move around (response option 6) and those who did not provide an answer (response option 7) were excluded from the analyses.

Statistical analyses

A protocol of the present analyses, including a pre-specified analysis plan, has been published prior to the statistical analyses (*https://osf.io/emaq2/*).

Before we aggregated the data from the two waves, we carried out a preparatory analysis to test if the data from both survey waves differ significantly regarding reported health behaviour changes (see Table 1).

Table 1. Preparatory analysis: Measure of correlation of both survey waves (unweighted data)

	Wave 24[II]	Wave25[II]	Chi-square test
Tobacco smoking	100 % (n=620)	100 % (n=581)	1578 (df=4)
During the time of corona restrictions, I...			
smoked much more than before	5.5 (34)	4.3 (25)	
smoked somewhat more than before	17.9 (111)	16.9 (98)	
smoked the same amount than before	66.3 (411)	67.5 (392)	p=0.813
smoked somewhat less than before	6.9 (43)	7.2 (42)	
smoked much less than before	3.4 (21)	4.1 (24)	
Alcohol consumption	100 % (n=1494)	100 % (n=1537)	4.152 (df=4)
During the time of corona restrictions, I...			
drank much more alcohol than before	1.5(22)	1.3 (20)	
drank somewhat more alcohol than before	10.5 (157)	9.3 (143)	
drank the same amount of alcohol than before	67.9 (1014)	69.7 (1071)	p=0.386
drank somewhat less alcohol than before	11.6 (173)	12.6 (193)	
drank much less alcohol than before	8.6 (128)	7.2 (110)	
Physical activity	100 % (n=2010)	100 % (n=2005)	13.173 (df=4)
During the time of corona restrictions, I (was)...			
much more active than before	5.3 (106)	3.9 (78)	
somewhat more active than before	13.0 (261)	11.7 (235)	
just as active as before	51.0 (1026)	55.9 (1120)	p=0.010
slightly less active than before	21.6 (434)	21.0 (422)	
much less active than before	9.1 (183)	7.5 (150)	

Notes. [II]Differences in the total number of respondents can be explained by people who refused to answer or reported that they do not smoke, drink alcohol or cannot move.

Prevalence data on self-reported health behaviour changes were analysed using descriptive statistics and presented as percentages together with 95 % confidence intervals (CI), calculated using the binom.test command in R. Version 4.1.0 (R Core Team, 2020). Data were weighted (reported as $\%_{\text{„w"}}$; $n_{\text{„w"}}$) to be representative of the German population accounting for personal and household characteristics.

Three separate multinomial logistic regression analyses (three categories: increase, no change, decrease) were used to analyse associations between each health behaviour and socioeconomic and sociodemographic characteristics of the respondents. All regression analyses used unweighted data.

Age in years was used as a continuous variable for the regression analyses, and as a categorical variable (14–17, 18–24, 25–39, 40–64, 65+) for the descriptive statistics. Monthly net household income was used as a continuous variable in € among over 18-year-olds (0–7000 € or more) for the regression analyses, and as a categorical variable (low, middle, high income) for descriptive statistics. Education was analysed as a categorical variable (low, middle, high level) for all analyses. Data were analysed using IBM SPSS version 25.

Regarding the total sample (n = 4078), 69.6 % (n = 2838) of the respondents reported not to smoke tobacco, 25.4 % (n = 1035) not to drink alcohol, and 1.4 % (n = 56) reported that they were unable to move around. Of the remaining samples for each health behaviour, missing data on health behaviour change was ≤1 %: smoking: 1.0 % (n = 39), alcohol consumption: 0.3 % (n = 12), physical activity: 0.2 % (n = 7). These data were excluded from the regression analyses. Missing values of predictor and outcome variables were sparse and therefore also excluded from the analyses.

Results

The preparatory analysis showed that survey waves 24 and 25 did not differ significantly regarding reported changes in smoking and drinking behaviours. However, a difference with a medium effect size was observed in self-reported changes in physical activity (Chi-square test [4] = 13.173, p = .010, n = 4015; Cramers V = 0.57).

Sociodemographic and socioeconomic characteristics of the total sample of 4078 respondents are presented in Table 2 (unweighted data). The mean age of the sample was 49.3 years (SD = ±18.6 years) and 51.1% (n = 2084) of the respondents were female.

Table 2. Sociodemographic and socioeconomic characteristics of the total sample of 4078 participants (unweighted data)

Age years (mean ± SD)	49.3 ± 18.6
14-17	3.8 (155)
18-24	9.4 (382)
25-39	19.3 (788)
40-64	44.0 (1795)
65+	23.5 (958)
Sex	
Female	51.1 (2084)
Male	48.9 (1994)
Education§	
Low	26.4 (1076)
Middle	36.6 (1493)
High	32.2 (1315)
Income''	
Low	12.8 (520)
Middle	64.6 (2633)
High	22.7 (925)

Notes. Data are presented as percentages (absolute numbers) within column unless otherwise noted. Differences when calculating the total percentages in column can be explained by missing data. §German equivalents to education levels listed from lowest to highest: low=no qualification or junior high school equivalent ("Hauptschulabschluss"), middle=secondary school equivalent ("Realschulabschluss"), high=advanced technical college equivalent ("Fachhhochschulreife") or high school equivalent ("Allgemeine Hochschulreife"). ''Income is listed from low to high: income in three categories: low (=approximately < 20th income percentile), middle (=approx. 20th to 80th income percentiles), and high (=approx.>80th income percentile). The sample of all available DEBRA waves is roughly comparable with the income distribution in the German population.

Figure 1 presents prevalence data on reported health behaviour changes for each health behaviour. Around one-quarter of the respondents reported an increase in smoking during COVID-19 restrictions compared to the time before (24.0 %$_w$, 95 %CI = 21.5–26.7 n_w = 264), whereas the majority (63.7 %$_w$, 95 %CI = 60.8–66.5; n_w = 700) reported no change and 12.2 %$_w$ (95 %CI = 10.4–14.4; n_w = 135) reported a decrease in smoking during this time.

Regarding changes in alcohol consumption 12.9 %$_w$ (95 %CI = 11.7–14.1; n_w = 384) of the respondents reported an increased consumption, 67.3 %$_w$ (95 %CI = 65.6–69.0; n_w = 2006) no change, and around one out of five persons (19.9 %$_w$, 95 %CI = 18.4–21.3; n_w = 592) reported drinking less alcohol than during the time before the first strict COVID-19 restriction in Spring 2020.

An increase in the level of physical activity was reported by 18.5 %$_w$ (95 %CI = 17.3–19.7; n_w = 727) of the respondents, no change was reported by 52.1 %$_w$ (95 %CI = 50.5–53.6; n_w = 2048), and 29.4 %$_w$ (95 %CI = 28.0–31.0; n_w = 1158), of the respondents, were less active than before.

The results of the three multinomial ordinal regression analyses are presented in Table 3.

Tobacco smoking

We found that higher age was associated with reduced odds of increased or decreased tobacco consumption (increase: OR = 0.98, 95 %CI = 0.97–0.99; decrease: OR = 0.99, 95 %CI = 0.98–1.00, per year). Respondents with lower educational levels also had lower odds of reporting a decrease in tobacco smoking (middle educational level: OR = 0.61, 95 %CI = 0.40–0.95; low educational level: OR = 0.49, 95 %CI = 0.28–0.85) compared to people with a high level of education. With higher income, the odds of reporting an increase in tobacco consumption increased (OR = 1.30, 95 %CI = 1.08–1.58).

Alcohol consumption

Similar associations were found when comparing an increase, respectively decrease, in alcohol consumption. The associations were more pronounced here, especially between age and low educational level and a decrease in alcohol consumption. A higher age was on the one hand associated with reduced odds of increased alcohol consumption (OR = 0.98, 95 %CI = 0.97–0.98) and on the other hand with reduced odds of decreased alcohol consumption (OR = 0.99, 95 %CI = 0.98–0.99) compared to no change in alcohol consumption.

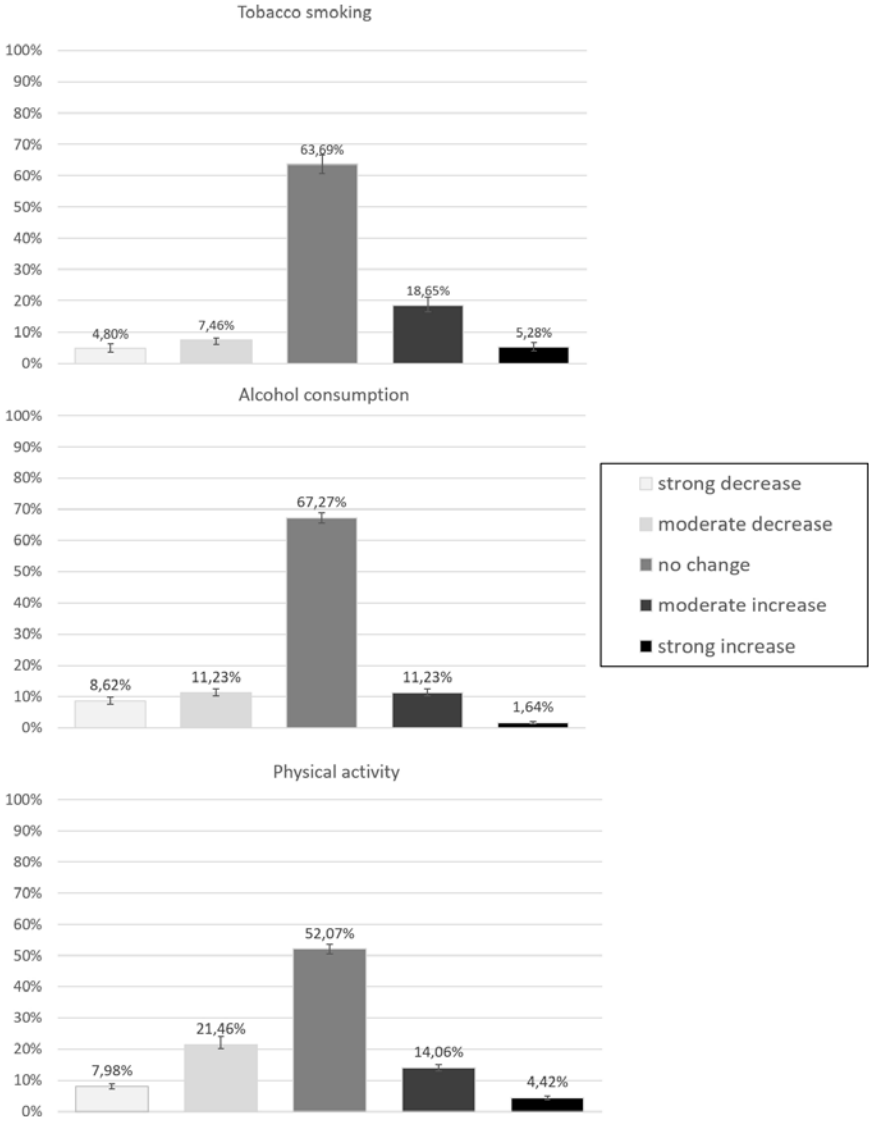

Figure 1. Prevalence data on self-reported health behaviour changes during the first COVID-19 restrictions (March to May 2020) compared to the time immediately before these restrictions were implemented (with 95 % confidence interval, weighted data).

Physical activity

The associations regarding physical activity showed quite a similar pattern. Men had lower odds than women to have decreased their level of physical activity (OR = 0.80, 95 %CI = 0.70–0.93). Again, the analyses show that people with lower educational levels also had lower odds of changing their physical activity level during the strict restrictions, and this applied to both a decrease (middle educational level: OR = 0.83, 95 %CI = 0.70–0.99; low educational level: OR = 0.71, 95 %CI = 0.58–0.87) and an increase (middle educational level: OR = 0.63, 95 %CI = 0.51–0.77; low educational level: OR = 0.40, 95 %CI = 0.30–0.52) compared to people with a high level of education.

Discussion

Main findings of this study

The majority of the German population (52–67 %) did not report changes in their health behaviour regarding their smoking behaviour, alcohol consumption, and physical activity during the first wave of the COVID-19 restrictions in spring 2020 compared to the time immediately before. Nevertheless, more respondents reported having smoked more than compared to those who reported having smoked less. Findings concerning the level of physical activity were similar: more people reported having exercised less than those who exercised more. However, the results for alcohol consumption were different: slightly more re-

Table 3. Results of three multinomial logistic regression analyses: Associations of changes regarding smoking behaviour, alcohol consumption and physical activity during the first COVID-19 restrictions in Germany with socioeconomic and sociodemographic characteristics of respondents (unweighted data)

Covariates[$]	OR (95% CI)					
	Tobacco smoking		Alcohol consumption		Physical activity	
	Decrease vs. no change	Increase vs. no change	Decrease vs. no change	Increase vs. no change	Decrease vs. no change	Increase vs. no change
	N=1167[#]		N=2954[#]		N=3826[#]	
Age[§]	0.99 (0.98-1.00)*	0.98 (0.97-0.99)***	0.99 (0.98-0.99)***	0.98 (0.97-0.98)***	1.00 (0.99-1.00)	0.98 (0.97-0.98)***
Sex						
Female (reference)	1	1	1	1	1	1
Male	0.74 (0.50-1.09)	0.88 (0.66-1.17)	1.11 (0.92-1.34)	1.01 (0.80-1.28)	0.80 (0.70-0.93)**	0.87 (0.73-1.05)
Education[‡]						
High (ref)	1	1	1	1	1	1
Middle	0.61 (0.40-0.95)*	1.00 (0.70-1.42)	0.82 (0.66-1.01)	1.04 (0.79-1.36)	0.83 (0.70-0.99)*	0.63 (0.51-0.77)***
Low	0.49 (0.28-0.85)*	1.30 (0.88-1.93)	0.60 (0.46-0.78)***	0.88 (0.63-1.25)	0.71 (0.58-0.87)***	0.40 (0.30-0.52)***
Net household income[§]	1.22 (0.95-1.56)	1.30 (1.08-1.58)**	1.00 (0.89-1.13)	1.26 (1.08-1.46)**	1.02 (0.92-1.13)	1.19 (1.06-1.34)**

Notes. [$]Analyses were adjusted for all listed covariates. Data are presented as odds ratios (OR) together with a 95% confidence interval (95% CI).* p< 0.05 **p<0.01 ***p≤0.001.[§]Age and income (net household income in Euro [€] per month among over 18-year-olds [€0 to €7000 or more]) were treated as continuous variables for regression analyses. [#]Selected cases (included in analyses). [‡]German equivalents to education levels listed from lowest to highest: low=no qualification or junior high school equivalent ("Hauptschulabschluss"), middle=secondary school equivalent ("Realschulabschluss"), and high=advanced technical college equivalent ("Fachhhochschulreife") or high school equivalent ("Allgemeine Hochschulreife").

spondents reduced their alcohol consumption instead of increasing it.

Our results are comparable with the current figures of the Federal Statistical Office: in the "corona year" 2020, the per capita consumption in Germany for various alcoholic beverages decreased (e.g., -5.4 % for beer). As possible reasons, the experts cite a lack of drinking opportunities due to closed gastronomy and the absence of many festivities (Destatis, 2021b). On the other hand, 5.0 % more tobacco products were taxed than in the previous year (2019). A strong increase was observed in fine-cut tobacco (+10.6 %). This increase is assumed to be due to the lack of availability of alternative low-priced cigarettes from other countries and the fact that people roll their own cigarettes (Destatis, 2021a).

We found associations between changes in all three health behaviours that have been examined and links to specific individual characteristics, such as higher age, lower level of education, and higher net household income. Comparable associations have also been found by other international research groups (Busse et al., 2021; Constandt et al., 2020; Garnett et al., 2021; Vanderbruggen et al., 2020). As previous studies suggested, aspects such as financial stress, boredom, and anxiety seem to be associated with health behaviour changes during country-specific restrictions (Busse et al., 2021; Garnett et al., 2021; Grossman et al., 2020; Stanton et al., 2020; Vanderbruggen et al., 2020).

Current studies report heterogeneous results regarding these changes (Busse et al., 2021; Constandt et al., 2020; Di Renzo et al., 2020; Garnett et al., 2021; Grossman et al., 2020; Lesser & Nienhuis, 2020; Manthey et al., 2020; Naughton et al., 2021; Siddiqi et al., 2020; Stanton et al., 2020; Vanderbruggen et al., 2020). Many of these studies were conducted as online surveys, and data were reported as not being representative for the general population of the respective countries. The objectives of these studies were often to obtain an initial overview about trends in pandemic-related health behaviour changes. Furthermore, the duration of the restrictions, as

well as the severity of the measures (e.g. curfews) varied between countries.

Regarding tobacco consumption, our data showed that significantly more people increased (24 %) than decreased (12 %) their smoking behaviour during the pandemic-related restrictions. A smaller change in smoking behaviour was reported by a group from Belgium: increase 7.4 %, decrease 2.5 % (Vanderbruggen et al., 2020). Worldwide, there seem to be different tendencies regarding changes in tobacco consumption. For example, data from Pakistan showed that the majority of smokers reported a strong decrease (68 %) in smoking (Siddiqi et al., 2020). In contrast, a high increase (43 %) in tobacco smoking was reported in a different study from Germany (n = 558) and was particularly observed among people with a lower level of education or among people whose living conditions have changed due to the pandemic (Georgiadou et al., 2020). At the beginning of the pandemic, some press releases spread ambiguous information on potential associations between smoking, hospitalisation and mortality rates, may have led to uncertainties among the smoking population (Simons, Shahab, Brown & Perski, 2021).

In our study more people reported drinking less alcohol (20 %) than more (13 %) during the COVID-19 restrictions. A large study from 21 European countries (n = 40 064) also showed a decrease in alcohol consumption during the period of restrictions (April 24th-July 22nd 2020). In Germany, however, this decrease was less pronounced than in other European countries. The authors see possible reasons for this in the increase in alcohol consumption among women and people with risky consumption patterns (Manthey et al., 2020). However, other studies reported an amplified increase in alcohol consumption during the country-specific restrictions (Garnett et al., 2021; Georgiadou et al., 2020; Vanderbruggen et al., 2020; Winstock et al., 2020): an international online survey carried out from May-June 2020 (N = 55811) revealed major changes in alcohol consumption: around 36 % consumed (slightly) more alcohol, and 22 % (slightly) less (Winstock et al., 2020). The motivational reasons for increased consumption include boredom, lack of social contact and the lack of a daily structure (Vanderbruggen et al., 2020), but also an increase in symptoms of anxiety, depression, and stress (Stanton et al., 2020).

In our study, more people reported having exercised less than more during the COVID-19 restrictions. This may be explained by a reduction of opportunities to exercise indoors, such as the closure of fitness studios and other leisure facilities. Other international studies (Constandt et al., 2020; Di Renzo et al., 2020; Naughton et al., 2021) showed that the type of training (strength training, endurance training), the sport location (indoor-/outdoor-sport) the level of activity before restrictions (active vs. not active) (Lesser & Nienhuis, 2020), the type of sport (team sport vs. individual sport) (Constandt et al., 2020), and the offer of online courses may be the reason for behaviour change of physical activity during this time. Reasons given were less time available, more time sitting and fewer opportunities to engage in competitive or team sports (Constandt et al., 2020). A web-based survey conducted in May 2020 (12–29th) among 5021 students of four German universities (mean age 24.4 years) found that 30.6 % reported an increase in vigorous physical activity, whereas 19.3 % reported a decrease (Busse et al., 2021). Factors associated with a change in health behaviour were female sex, younger age, being bored and having depression symptoms. Specific groups of society might have gained more spare time due to the new circumstances, and the availability and uptake of online courses might have increased (Kehl, Strobl, Tittlbach & Loss, 2021). These could be important contributors, which might have maintained or even increased the level of physical activity during the restrictions.

What this study adds

Our data help to identify and analyse the changes in health behaviours in response to the COVID-19 restrictions; concerning the consumption of tobacco cigarettes, alcoholic beverages, and the levels of physical activity in a representative sample of the German population. In addition, our findings complement data from many other countries around the world. Our data suggest that the restrictions in spring 2020 may have had an impact on the health behaviours of people living in Germany. Some people had the chance to improve their health behaviours during the pandemic, but for many others (especially smokers) there appeared to be significant negative health consequences. It would be interesting to establish, whether a switch to new formats (such as online courses) might counteract a decrease in the level of physical activity, and whether there are differences between various types of sports (e.g. strength training, team sports, other activities, etc.)

Limitations of this study and conclusion

The present study has some limitations. First, there was a time lag between the survey period (June-August 2020) and the period of interest in our study (March-May 2020), which may have increased the risk for recall bias. Second, data were assessed by self-reports. People may answer in a socially desirable way, for example by reporting a lower alcohol and tobacco consumption, or higher physical activity. Another aspect is that no causal relationship between a change in health behaviour and the pandemic-re-

lated restrictions can be established by employing a cross-sectional study design. Another limitation of the study is that the methodology of the market research institute conducting the survey does not allow for calculating the response rate or for a comparison between responders and non-responders.

Nevertheless, we used a large and representative sample and were able to analyse associations of health behaviour changes with various socioeconomic and sociodemographic characteristics.

The first national COVID-19 restrictions in 2020 influenced the health-related behaviour of around 40 % of the people living in Germany. People with a lower level of education, those with higher incomes and those of younger age seemed to be particularly vulnerable to negative influences on health behaviour change. One could speculate that the pandemic may have led to unfamiliar working situations (remote work especially in jobs with higher salaries and possibly family presence or isolation), which may in turn have led to increased stress and thus an increase in smoking/drinking behaviour (Nielsen, Christensen & Knardahl, 2021). As changes due to the pandemic revert only at a slow pace, the monitoring of health behaviour changes will remain important. Health policies need to be developed to counteract negative changes and support positive changes in health behaviours. Targeting particularly those groups most strongly affected should be taken into consideration.

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Stephanie Klosterhalfen: Formal analysis, Data curation, Writing original draft, Visualization. Daniel Kotz: Conceptualization, Methodology, Validation, Writing – review & editing, Supervision, Project administration, Funding acquisition. Sabrina Kastaun: Conceptualization, Methodology, Validation, Writing – review & editing, Supervision, Project administration. All named authors contributed substantially to the manuscript and agreed on its final version.

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