



The effect of COVID-19 on schoolteachers' emotional reactions and mental health: longitudinal results from the CLASS study

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Abstract

Purpose We investigated schoolteachers' emotional reactions to COVID-19 and mental health during three phases of the COVID-19 pandemic. We further analyzed if teachers, who belonged to a COVID-19 risk group, had more emotional reactions and poorer mental health than “non-risk” groups.

Methods We collected questionnaire data in May, June, and November–December 2020 and used data from 2665 teachers at public schools (871 individuals participated in all three surveys). Participants reported their fear of infection, fear of transmission of infection to their home or pupils, perceived burnout and stress, and worries about their ability to manage the working conditions. We included information about COVID-19 risk group status, gender, age, organization of teaching (physical presence or remote teaching), and the pupils' grade. We estimated prevalence ratios and took repeated measures into account.

Results Emotional reactions and poor mental health increased significantly with 27–84% from May to November–December 2020. Teachers, who were particularly vulnerable to the adverse consequences of COVID-19, had the highest prevalence of fear of infection and poor mental health.

Conclusion Teachers play a crucial role in a society's response to a pandemic. Yet, the dual role of teaching and virus control along with concerns regarding the health consequences of an infection may contribute to the observed increase in emotional reactions to COVID-19 and poor mental health.

Keywords COVID-19 · Mental health · Occupational health · School teachers · Longitudinal studies

Introduction

The COVID-19 pandemic has profound implications for the working environment among frontline employees (Burdorf et al. 2020). Frontline employees encompass job groups working with customers, clients, patients, pupils, etc. and they often maintain essential functions that cannot be maintained from home (The Lancet Editorial 2020). Not surprisingly, the working environment and mental health particularly among healthcare professionals have received attention during the pandemic (Chew et al. 2020; Huang and Zhao 2020; Song et al. 2020; Sun et al. 2020; Vindegaard and Benros 2020). Yet, when it comes to the control of a virus outbreak, also institutions outside of the hospital sector play a major role, for example, public schools.

Globally, school closures are a frequently used approach to control virus outbreaks (Viner et al. 2020). Yet, according to UNESCO, the duration of school closures varies considerably between different countries and regions (UNESCO

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2021). Thus, when schools are open during pandemics, schoolteachers are expected to hinder spread of infection while carrying out their core tasks (Li et al. 2020a). We hypothesized that this double role, combined with the risk of infection due to multiple social contacts, affects teachers' emotional reactions to COVID-19 and mental health, and these consequences may be more pronounced in risk groups that are particularly vulnerable to severe illness in the case of an infection with SARS-Cov-2 (Preskorn 2020).

Knowledge about these effects of the pandemic is not only of importance for teachers, but also for pupils, parents and the school leaders, who are directly or indirectly affected by teachers' wellbeing (Naghieh et al. 2015). Additionally, the teachers' ability to navigate their double role during pandemics, i.e., hindering spread of infection while teaching, is of interest to society as a whole due to the spillover effect of virus outbreaks at schools on the infection rates in the society, pressure on the health care sector, and the economy.

A range of cross-sectional studies conducted during the 2020 lock-down describe teachers' mental health problems in the context of COVID-19 (Aperribai et al. 2020; Li et al. 2020b; Lizana and Vega-Fernandez 2021; Sokal et al. 2020b; Stachteas and Stachteas 2020; Zhou and Yao 2020), while one Spanish cross-sectional study reported the level of poor mental health among teachers in relation to reopening of schools (Ozamiz-Etxebarria et al. 2020). Interestingly, one UK report described fluctuations in anxiety among teachers from October 2019 to September 2020 and highlighted peaks in anxiety in the week before initial lockdown and again in the week that a school re-opening was announced (Allen et al. 2020). In Chilean teachers, quality of life decreased during the pandemic compared with pre-pandemic measures (Lizana et al. 2021), and a study among Canadian teachers reported increased exhaustion and cynicism during the first three months of the pandemic (Sokal et al. 2020a). Thus, teachers' mental health may be challenged during the pandemic, but due to the cross-sectional nature of the majority of previous studies, there is still a lack of knowledge about the consequences of being in the frontline and the resulting changes in teachers' mental health during different phases of the COVID-19 pandemic.

The aim of the present study was, therefore, to investigate changes in schoolteachers' emotional reactions to COVID-19 and mental health during three phases of the COVID-19 pandemic in Denmark: A semi-initial phase with a partial school closure and declining infection rates (May 2020), an intermediate phase with open schools and low infection rates (June 2020), and in the beginning of a second wave with high and increasing infection rates and open schools (November–December 2020). We further analyzed if the effect of the pandemic on emotional reactions and mental health was stronger among teachers in a COVID-19 risk group.

Methods

Data collection

We used data from baseline, 1st and 2nd follow-up of the CLASS study. CLASS is a national research project on the effects of COVID-19 on teachers' working environment, sense of community and perceived risk of infection in Denmark. Data were collected via an online questionnaire between 6 and 17 May 2020, 16 and 26 June 2020, and 25 November to 9 December 2020. The questionnaires were distributed by email including 1–2 reminders. The Danish Union of Teachers (DLF), which organizes teachers employed in public schools in Denmark, managed the data collection. In the invitation to the survey, it was highlighted that participation was voluntary, that responses were confidential, and that individuals or workplaces could not be identified, when results were published. A link to further information was provided to fulfill the requirements of the Data Protection Regulation. In Denmark, questionnaire surveys do not need ethical approval.

Context

Figure 1 illustrates the context of the data collection in relation to different phases of the COVID-19 pandemic. In Denmark, the first case of COVID-19 was identified 26 February 2020, and 11 March 2020 a total lock-down of all public workplaces apart from critical functions was announced. During the lock-down, public teachers implemented remote emergency teaching. By 17 April 2020, public schools were re-opened for the youngest pupils [0th (approx. 6–7 years old) to 5th grade (approx. 11–12 years old)]. During the baseline data collection, a re-opening was announced starting from 18 May for older pupils [6th grade (approx. 12–13 years old) to 10th grade (approx. 16–17 years old)]. During the summer and fall, all public schools were open apart from temporary local or regional school closures in the case of local outbreaks. From 9 December 2020, i.e., the last day of the data collection for the 2nd follow-up, public schools were closed again, now including 5th to 10th grade.

Study population

DLF has approximately 50,000 members. The initial study population consisted of a random sample of the members of DLF, who were employed as teachers in public schools. In total, 10,000 members were contacted. Participants were eligible for inclusion if they were currently engaged in teaching either remotely or physically (or both) at the

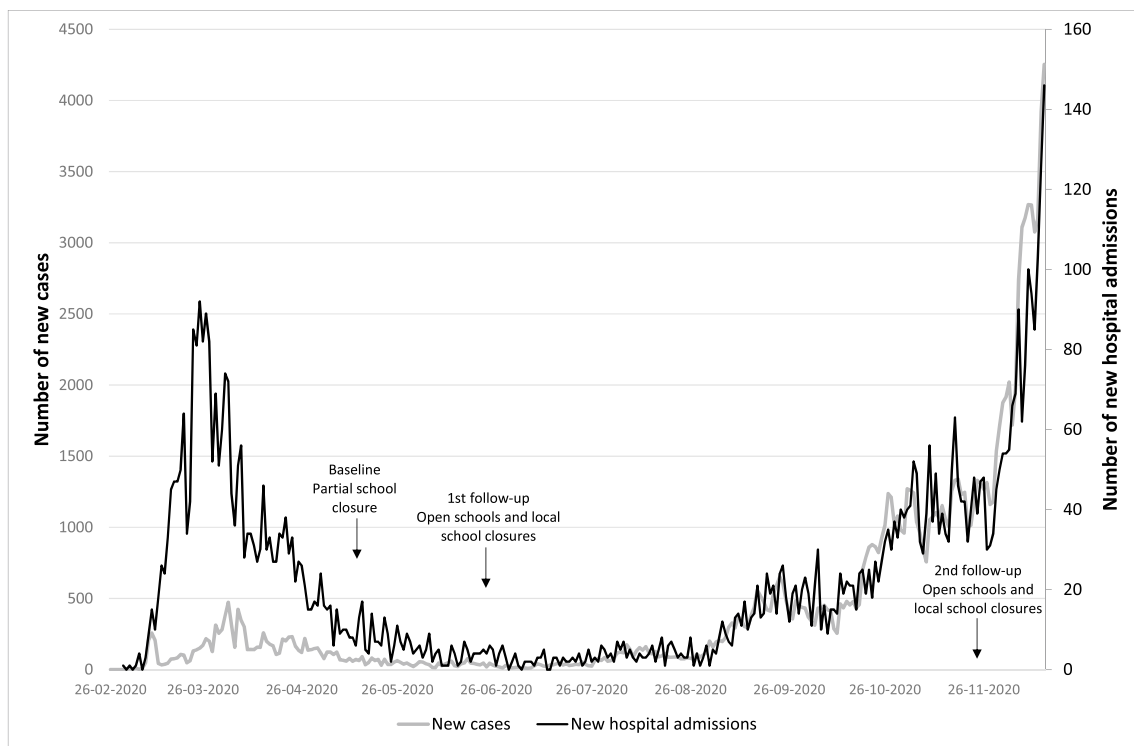


Fig. 1 Overview of the context of the data collection. The figures are based on publicly available data from “Statens Serum Institut” (Statens Serum Institut 2021) Note: The number of newly infected in the spring and in the fall is incomparable due to difference in the test-

ing strategy. The mean number of daily hospital admissions with COVID-19 during the days of data collection was 9 (May 2020), 4 (June 2020), and 54 (November–December 2020)

schools at the time of the survey. Only teachers working at least partly outside of the specialized area (comprising children with special needs) were included. Figure 2 shows a flow diagram of the respondents of each survey. The response rates were 30% (baseline), 54% (1st follow-up), and 59% (2nd follow-up). Response rates did not differ substantially between men and women, but the response rate was lowest in Region North Jutland and among those, who were below 40 years old. Among CLASS participants, particularly the younger age group (20–39 years) was underrepresented, while the older age groups (50–59 years and ≥ 60 years) were overrepresented, as compared with DLF members in general. Among those who fulfilled the inclusion criteria and participated in *at least* one survey, we excluded individuals missing on age and gender leaving us with an analytical sample of $n = 2665$ at baseline, $n = 1239$ at 1st follow-up, and $n = 1329$ at 2nd follow-up. In total, 871 individuals were eligible for inclusion, had non-missing data on age and gender, and participated in *all three* surveys. The distribution of sociodemographic factors, current teaching, and risk group status in the total sample and among those who participated in all three surveys is displayed in Table 1.

Variables

Sociodemographic factors

Information about gender, age and region was obtained from DLF’s members’ register. Cohabitation was assessed with the question “Do you live together with...?” (Response options: My parents, Partner, Other adults, Children in 5th grade or younger, Children in 6th grade or older, I live alone), and participants were categorized in four groups (see Table 1).

Current teaching

We obtained information about the organization of the participants’ teaching [How is your teaching currently organized? Response options: Teaching at the school, Remote teaching, I do not teach currently (The latter group was excluded from the survey)], and the pupils’ grade (What grades are you currently teaching? 0th grade...10th grade). Hybrid teaching was not available as a response category.

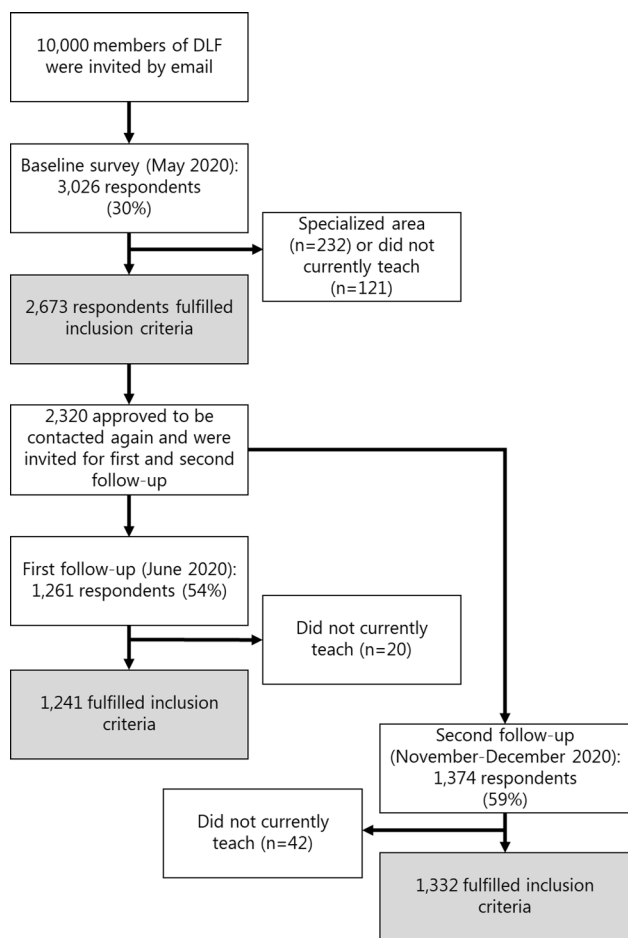


Fig. 2 Flow diagram of the participation in each survey (baseline, first and second follow-up). The analytical samples were as follows: Baseline $n = 2665$, first follow-up $n = 1239$, second follow-up $n = 1329$, and available data from all three surveys $n = 871$

Emotional reactions

Participants were asked: If you think about your current situation, do you agree or disagree with the following statements...? (a) I fear being infected with COVID-19 during my work; (b) I fear to transmit infection from my workplace to my home; (c) I fear transmitting infections to my pupils during work [Response options: (1) Highly agree, (2) Agree, (3) Neither agree nor disagree, (4) Disagree, (5) Highly disagree]. The variables were dichotomized and participants who agreed or highly agreed were considered as having an emotional reaction. Only participants who had been physically present at the school in the preceding period (either teaching or at meetings, picking up material, printing, etc.) were responding to these questions. At baseline, the Cronbach's Alpha for the three original items was 0.86.

Table 1 Description of the baseline sample eligible for inclusion (total sample) and the subsample who participated in all three surveys (May, June and Nov–Dec 2020)

	Total sample $N = 2665$		Subsample $N = 871$	
	%	n	%	n
Gender				
Female	76	2032	78	675
Male	24	633	23	196
Age				
< 40 years	20	522	14	121
40–49 years	33	875	33	289
50–59 years	33	875	38	333
60 years or older	15	393	15	128
Region				
Capital	26	701	24	211
Zealand	15	402	16	141
Southern Denmark	11	281	10	84
Mid Jutland	25	673	27	231
North Jutland	23	608	23	204
Cohabitation				
Live alone	11	300	11	100
Live solely with children	10	258	7	64
Live solely with other adults	37	983	38	335
Live with children and adults	42	1124	43	372
Grades ^a				
0.–3. grade	39	1035	40	346
4.–6. grade	44	1174	45	388
7.–10. grade	39	1034	38	334
Type of teaching				
At the school	50	1337	51	445
Remote teaching from home	33	880	30	265
Both	17	448	19	161
Belongs to a risk group in relation to COVID-19 ^b				
No	83	1025	83	726
Yes	14	171	13	114
Do not know/do not wish to report	4	43	4	31
Missing data	–	1434	–	0

^aParticipants could teach more than one grade. ^bData extracted from June survey. Participants who reported “Do not know/do not wish to report” were excluded from the analyses of this variable

Mental health

Participants were asked the following questions: (d) Have you felt stressed during the past 2 weeks? [Response options: (1) All the time, (2) Often, (3) Sometimes, (4) Seldom, (5) Never]; (e) Do you feel burned out because of your work?; (f) Does it worry you whether you can manage working under the current conditions for a longer period of time? (Response options for item e and f: To a very high degree,

To a high degree, To some degree, To a small degree, Not at all). The variables were dichotomized, and participants in the first two categories were considered as having poor mental health. At baseline, the Cronbach's Alpha for the three original items was 0.87.

Risk group status

In June 2020, participants were asked if they belonged to a COVID-19 risk group (Response options: Yes, No, Do not know, Do not want to answer). Participants were presented with the Danish Health Authorities' definition of risk groups, which are individuals who are above the age of 80 years or institutionalized, adults who are obese or have a chronic disease, children with a chronic disease making them vulnerable to infections, and pregnant women. As we did not have information about risk-group status from the baseline survey (May 2020), analyses of the effect of being in a risk group on emotional reactions and mental health were only conducted in the subsample with information from all three surveys. Also, those who did not know or who did not want to respond to this question were excluded from these analyses ($n=43$).

Statistical analyses

First, we analyzed the distribution of sociodemographic variables and other covariates in the two analytical samples, i.e., the "total sample" (i.e., all respondents at each time point) and the "subsample" (i.e., only respondents who participated at all time points) (Table 1).

Second, we described the level of emotional reactions and mental health across the three phases of the pandemic in both samples (Fig. 3), and analyzed differences across time (May, June, November–December) with adjustment for gender, age, region, cohabitation, organization of teaching, and the pupils' grades in the total sample (Table 2).

Third, in the subsample, we investigated changes in emotional reactions and mental health among teachers, who belonged to a COVID-19 risk group compared with teachers, who did not belong to a risk group, with formal test of multiplicative interaction by adding a "Time \times Risk group" interaction term (Table 3).

We used repeated measurements logistic regression as implemented in the *glm*-procedure in STATA version 15.1. Prevalence ratios (PR) with 95% confidence intervals (CI) were used as effect estimates. In these analyses, the clustered nature of the data was taken into account using the STATA command for robust clusters.

In our attrition analyses, we investigated if emotional reactions and mental health at baseline/1st follow-up were associated with the probability of participation in the following survey, i.e., 1st follow-up/2nd follow-up. We

cross-tabulated all outcome variables with "participation" in the following survey. Significance tests were obtained from binary logistic regression in which all measures of emotional reactions and mental health were mutually adjusted.

Results

We found that teachers' fear of infection and transmission as well as their perceived level of stress and burnout and their worries about their ability of managing the working conditions increased from May to November–December 2020. Importantly, in June 2020, we observed a tendency to a stagnation or even a decline in more of these outcomes (Fig. 3A).

The adjusted analyses in the total sample (Table 2) confirm the descriptive findings, with a relatively stable level in the spring and summer followed by a significant increase in all outcomes in the fall with effect estimates indicating a 27–84% higher prevalence of emotional reactions and poor mental health at 2nd follow-up. Notably, already at 1st follow-up, teachers' seemed to worry more about their ability to manage the working conditions, with a change that bordered on statistical significance (PR = 1.11; 95% CI 0.98–1.27). At the same time (June), fear of transmission to pupils and the level of perceived stress declined.

We also found that teachers, who reported being in a COVID-19 risk group, had a higher level of emotional reactions and poor mental health at most of the measurement points. Notably, in the beginning of the pandemic, we observed a substantial difference between risk groups and non-risk groups (Fig. 3B). The adjusted analyses demonstrated a considerable increase in prevalence of emotional reactions and poor mental health in the risk group, but for fear of infection and fear of transmission to the home the increase was actually lower than expected from the main effects. For the remaining outcomes, the Time \times Risk group interaction term was statistically insignificant (Table 3).

Our attrition analyses showed that the outcomes under study were not systematically associated with drop-out from the study. In total, 47% of baseline respondents participated in 1st follow-up. Only fear of transmission to family was significantly ($p < 0.05$) associated with a lower probability of subsequent participation (45% versus 50%). In total, 70% of the participants in 1st follow-up participated in 2nd follow-up. A higher probability of participation was borderline statistically significantly ($p < 0.1$) associated with fear of transmission to the home (72% versus 69%) and perceived stress (75% vs. 69%).

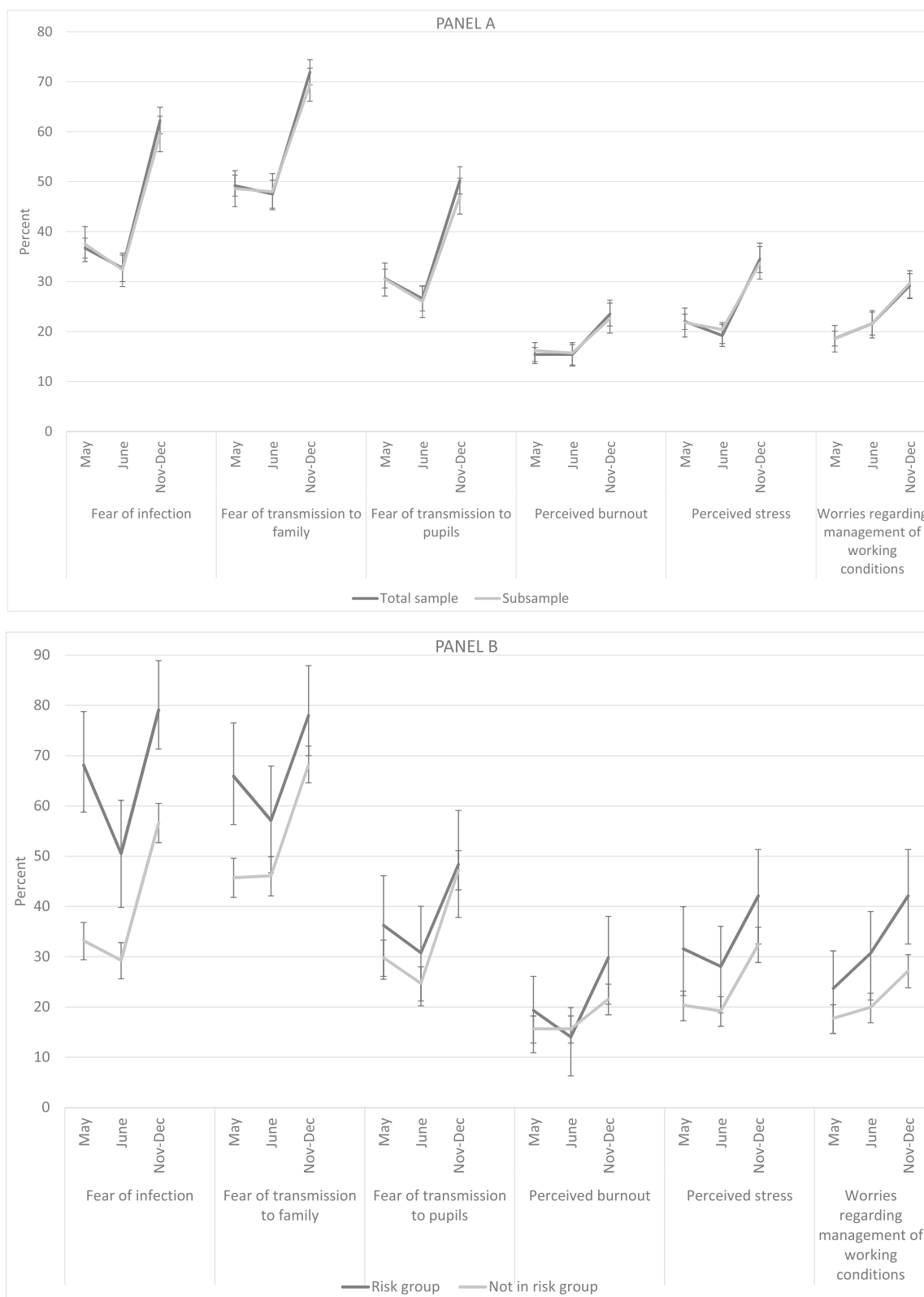


Fig. 3 **A** Changes in emotional reactions to COVID-19 and mental health among schoolteachers in three phases of the COVID-19 pandemic in Denmark. Separate lines are presented for the total sample at each survey and in the subsample consisting of individuals who participated in all three surveys. **B** Changes in emotional reactions to

COVID-19 and mental health among schoolteachers in three phases of the COVID-19 pandemic in Denmark. Separate lines are presented for those who reported that they belonged to a risk group and those who did not. Only participants with data from all three surveys are included

Table 2 Emotional reactions and mental health in June and November–December 2020 (with May as reference) in the total sample, i.e., all participants with non-missing data in one or several surveys are included

	June 2020		Nov–Dec 2020	
	PR	95% CI	PR	95% CI
Emotional reactions				
Fear infection	0.93	0.86–1.02	1.84	1.70–1.98
Fear transmission to home	0.98	0.92–1.05	1.52	1.43–1.61
Fear transmission to pupils	0.89	0.80–0.99	1.71	1.56–1.87
Mental health				
Perceived burnout	0.87	0.75–1.02	1.27	1.10–1.47
Manage working conditions	1.11	0.98–1.27	1.44	1.26–1.64
Perceived stress	0.86	0.76–0.98	1.51	1.34–1.69

Adjusted for gender, age, region, cohabitation, organization of teaching, and pupils’ grade

PR prevalence ratios, CI confidence intervals

Discussion

Main findings

We found a relatively stable level of the outcome measures from the semi-initial phase of the pandemic (in the wake of the first peak) to the intermediate phase with low infection rates. At this time point, only worries about the ability of managing the working conditions seemed to increase, although emotional reactions to the virus per se (i.e., fear of infection and transmission) seemed to decline somewhat. When facing the second wave of the pandemic, emotional reactions and poor mental health increased with 27–84% in an adjusted model. Finally, being in a COVID-19 risk group was associated with substantially more prevalent emotional reactions and poor mental health, but contrary to our expectation, they did not *increase* more than the non-risk group.

Comparison with previous studies

Whereas most previous studies have mainly been preoccupied with teachers’ working conditions during lock-down and the consequent implications of remote teaching (Aperribai et al. 2020; Li et al. 2020b; Lizana and Vega-Fernandez

Table 3 The association between being in a risk group for COVID-19 and changes in emotional reactions and mental health in June and November–December 2020 (with May as reference)

	May 2020		June 2020		Nov–Dec 2020	
	PR	95% CI	PR	95% CI	PR	95% CI
Fear infection*						
Not in risk group	1.00		0.91	0.81–1.02	1.83	1.63–2.06
In risk group	2.06	1.72–2.48	1.59	1.26–2.02	2.61§↓	2.21–3.11
Fear transmission to home*						
Not in risk group	1.00		1.04	0.95–1.13	1.58	1.44–1.73
In risk group	1.49	1.26–1.76	1.34	1.10–1.63	1.89§↓	1.62–2.20
Fear transmission to pupils*						
Not in risk group	1.00		0.87	0.75–1.01	1.70	1.48–1.96
In risk group	1.24	0.92–1.67	1.12	0.80–1.58	1.80	1.38–2.35
Perceived burnout**						
Not in risk group	1.00		0.89	0.72–1.10	1.20	1.97–1.47
In risk group	1.37	0.90–2.07	0.86	0.53–1.40	1.78	1.25–2.52
Perceived stress**						
Not in risk group	1.00		0.96	0.81–1.15	1.59	1.34–1.89
In risk group	1.57	1.15–2.14	1.43	1.01–2.01	2.10	1.58–2.78
Manage working conditions**						
Not in risk group	1.00		1.07	0.89–1.29	1.45	1.18–1.77
In risk group	1.41	0.98–2.02	1.73	1.24–2.42	2.35	1.75–3.16

Participants with non-missing data in all three surveys were included as risk group-status was not available for all participants. Adjusted for gender, age, region, cohabitation, organization of teaching, and pupils’ grade

§Significant ($p < 0.05$) interaction between “Time” and “Risk group”; ↓Estimate lower than expected from separate main effects; * $n = 737$ (participants who had not been physically present at the school were not asked questions about fear of infection and transmission); ** $n = 840$

2021; Sokal et al. 2020b; Stachteas and Stachteas 2020; Zhou and Yao 2020), the present study addresses emotional reactions to COVID-19 and mental health outcomes among teachers, when schools were partly or mainly open. As has been observed among employees in healthcare and eldercare (Aoyagi et al. 2015; Goulia et al. 2010; Nabe-Nielsen et al. 2020; Seale et al. 2009), fear of infection and transmission of infection and poor mental health outcomes are also present among schoolteachers, and the level fluctuates with the infection/hospitalization rates in the society. A comparison of these fluctuations across nations is complicated by differences in the development of the pandemic as well as the political response, e.g., in terms of school closures (UNESCO 2021). Our findings do, however, resemble those of previous studies of related topics, despite that measurement tools are not exactly similar: A Spanish study reported the prevalence of poor mental health among teachers from pre-school education to university level (depression: 16%; anxiety: 29%; stress: 19%) when reopening educational institutions in September 2020 (Ozamiz-Etxebarria et al. 2020). These figures are similar to our observations from June 2020. One UK report described that the proportion of teachers experiencing high work-related anxiety peaked in the week before initial lockdown and again in the week that school re-opening was announced in June 2020 (Allen et al. 2020). Likewise, we observed a peak immediately before the second school lockdown in December 2020 (Dec 9: 5th to 10th grade; Dec 21: 0th to 4th grade), and also relatively high levels of the outcomes in May 2020 when the youngest pupils were back in school and a reopening for the oldest pupils was announced (Allen et al. 2020).

Based on these findings, knowledge about interventions that can mitigate the potential effects of the pandemic on teachers' mental health are needed. A Chinese study among teachers reported that the most preferred psychological intervention during the pandemic was practice of stress management skills followed by reading psychology education materials, receiving online psychological counseling, and using a telephone hotline (Lizhi et al. 2021). In the context of COVID-19, a mindfulness and cognitive reframing-intervention showed positive effects on resilience and psychological wellbeing of teachers (Zadok-Gurman et al. 2021). Another intervention study partly carried out during the pandemic reported positive effects of a 14-week training program on stress coping ability, burnout, information and communication technology competency and emotional intelligence in the classroom (Pozo-Rico et al. 2020). Thus, it appears that teachers' mental health could be improved through targeted interventions.

When it comes to teachers' risk of infection at the time of the data collection, children did not seem to play a major role in the transmission of SARS-CoV-2 (Macartney et al. 2020; Walger et al. 2020), and being physically present at the

schools did not seem to imply a substantially higher risk of infection and possible transmission to the pupils' parents and the teachers' partners compared with remote teaching (Vlachos et al. 2021). Nevertheless, the potential work-related exposure to virus could influence schoolteachers' perception of a safe working environment: In a previous paper, we found that having been exposed to infection *or* being unaware about exposure to infection were associated with more frequent emotional reactions to the pandemic (Nabe-Nielsen et al. 2021b). In the same vein, perceived risk of COVID-19 infection was associated with a higher level of perceived stress among health and social care professionals (Finell and Vainio 2020). Yet, the subsequent access to vaccination is likely to influence teachers' fear and risk of infection.

Previously, we reported that knowledge about adequate test-behavior and access to personal protective equipment (PPE) were associated with less frequent emotional reactions (Nabe-Nielsen et al. 2021b). Importantly, teachers are less accustomed to the use of PPE compared with, for instance, health professionals (Belingeri et al. 2020). Furthermore, the mere access to PPE may be insufficient: A Chinese study in teachers found that knowledge about proper mask use was necessary to mitigate poor mental health outcomes (Li et al. 2021). Additionally, the use of face masks as a PPE in teaching has been questioned due to its negative impact on verbal and non-verbal communication (Spitzer 2020). This finding corresponds with the findings regarding barriers for wearing face masks among healthcare workers (Houghton et al. 2020). From October 2020, schoolteachers in Denmark were allowed to use face shields. Yet, in CLASS data, 48% of the users reported that it affected their teaching negatively (Nabe-Nielsen et al. 2021a).

Also children can be taught basic hygiene (Walger et al. 2020), but ensuring that children adhere to guidelines regarding hindering spread of infection (e.g., hand washing, disinfection and physical distance) constitutes an additional task that requires time and efforts potentially reallocated from teaching activities (Nabe-Nielsen et al. 2021c). Thus, apart from the perceived threat of exposure to virus, the efforts to protect teachers and pupils from infection and hindering virus outbreaks in schools with subsequent local school closures could be the explanations for the emotional reactions and poor mental health.

Strengths and limitations

The validity of this study is strengthened by the longitudinal design with data collection during three distinct phases of the COVID-19 outbreak in Denmark. We collected data in collaboration with DLF, which enabled us to conduct a survey with a short notice. Labor unions have high legitimacy and a direct and unhindered access to their members. Thus, partnerships between researchers and labor unions provide

a unique opportunity for an agile data collection and subsequent dissemination of results.

Data for the current study were collected with a research purpose, which is a strength of our study. Nevertheless, the short time frame for the development of the questionnaires and the continuously changing circumstances did not allow for a thorough validation of the questionnaire. Furthermore, we required that the questionnaire could be filled in within less than 10 min. For this reason, we did not include already existing and comprehensive research-based scales for the assessment of fear of infection (Ahorsu et al. 2020; Bitan et al. 2020) or poor mental health, e.g., depressive symptoms (Bech et al. 2001). This is a limitation of the validity of our study, and therefore we do not argue that our single-item measures represent different underlying constructs. Actually, in an exploratory factor analysis, we found that the “emotional reaction variables” loaded on one factor and the “mental health variables” loaded on a second factor, and—not surprisingly—each of the two groups of variables is therefore highly interrelated.

Furthermore, although we adjusted for sociodemographic factors, organization of teaching, and the pupils’ grades, other factors, such as seasonal fluctuations may influence mental health, although a recent review questions a general seasonal effect on depressive symptoms (Øverland et al. 2019). Furthermore, some of the difference in, for instance perceived stress, could be due to already existing differences between employees with and without chronic conditions (Mutambudzi and Henkens 2020).

The overall response rate in CLASS ranged between 30% and 59%, and particularly younger age groups were underrepresented, which is a limitation (Nabe-Nielsen et al. 2021b). Yet, our attrition analyses demonstrated that emotional reactions and poor mental health were not systematically associated with drop-out between survey rounds. Furthermore, we found the exact same pattern of changes in the outcome variables (Fig. 3) when including all available data at each time point and when including only the subsample who participated in all three surveys. Participation required internet access via an electronic device (smartphone, laptop or tablet). We do not, however, perceive this as a limitation, as teachers are used to online communication with, for instance, parents, colleagues, and their labor union.

Data from the background population show that fluctuations in “worries about the corona crisis” followed the same pattern as similar indicators in our sample. Yet, the level of anxiety and poor mental health seemed to be more stable in the background population only interrupted by an apparent peak by the end of June 2020 (Coronaminds.dk 2021). We expect that the findings can be generalized to other occupational groups with multiple job-related physical contacts. We suggest that major changes in the organization of the work, i.e., going from remote work to physical presence or

vice versa, or being physically present at the workplace with many physical encounters while there are dramatic increases in the infection rates, yield emotional reactions and poorer mental health. Such effects may occur in various occupations, although, we cannot empirically support this claim in the current study. For each occupational group, we suggest that the effect of the pandemic on emotional reactions and mental health may depend on access to (and confidentially with the use of) PPE, adherence to instructions about containment of infection, actual exposure to infection, the perceived threat, training, the amount of additional tasks, social parameters such as support from leaders, and eventually the possibility of vaccination.

Conclusion

Working in the frontline and meeting multiple demands in this context may yield emotional reactions to COVID-19 and poor mental health. We found that teachers’ emotional reactions and mental health changed during three phases of the pandemic with the highest level of fear, worries and perceived burnout and stress when facing the second wave of the pandemic. Teachers, who belong to a COVID-19 risk group, most frequently reported emotional reactions and poor mental health. Continuous awareness of the working conditions of teachers is of importance as their performance is fundamental for the society as a whole. In the post-pandemic period, there may be a need for additional resources allocated to the public schools to catch up with any deficiencies in the acquired skills among pupils and to ensure sufficient staffing for this and other postponed tasks.

Author contributions The collaboration between the University of Copenhagen and Danish Union of Teachers was initiated by KN-N. The aim of this study was proposed by KN-N, KBC, and CJN, and it was discussed and agreed on among all authors. KN-N, NVF, IL, and CJN contributed to the development of the questionnaire, and NVF administered the data collection. KN-N drafted the manuscript. KBC, NVF, IL and CJN critically revised the first version of the manuscript. KN-N conducted the statistical analyses with support from KBC. The final version was critically revised and approved by all authors.

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Availability of data and materials Data are available and can be shared and used for research projects in collaboration with data owners.

Declarations

Conflict of interest NVF and IL are employed by the Danish Union of Teachers, which works for the promotion of its members’ salary level and working conditions. KN-N, KBC, and CJN declare no conflicts of interests.

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