



## Research Article

# Schooling-at-Home and Extra Child-Caring Responsibilities were Associated with Parental Mental Health, Psychosocial Well-Being, and Loneliness

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**Abstract:** Schooling-at-home and educating children at home have received increased attention since the COVID-19 pandemic which resulted in abrupt social changes, including stay-at-home protocols and school closures to prevent the spread of infection during the period. We examined the mental health, psychosocial well-being, and loneliness of parents according to whether they had been taking on extra schooling-at-home and child-care responsibilities. We conducted a multi-country cross-sectional online survey nine months into the COVID-19 pandemic in Norway, the UK, the USA, and Australia with a sample size of 1,722. Outcome measures included the General Health Questionnaire 12 (GHQ-12) mental health scale, the Psychosocial well-being (PSW) scale, and the De Jong Gierveld Loneliness Scale (LS). The key explanatory factor was parental and child-care status, which categorised participants based on how many extra child-care or schooling-at-home responsibilities were taken up. Moderator variables included working-from-home status, living arrangements, and demographic covariates. Our sample had 20.0% of parents who reported taking on some or half of the extra child-care responsibilities, and 11.7% reported that they were taking on most of the extra child-care responsibilities. Parents who were taking on most of the extra child-care or schooling-at-home responsibilities had poorer mental health ( $M = 17.34$ ,  $SE = 0.40$  vs  $M = 15.47$ ,  $SE = 0.37$ ,  $p = 0.002$ ), psychosocial well-being ( $M = 2.92$ ,  $SE = 0.05$  vs  $M = 2.72$ ,  $SE = 0.05$ ,  $p = 0.011$ ), and loneliness ( $M = 11.29$ ,  $SE = 0.31$  vs  $M = 10.33$ ,  $SE = 0.28$ ,  $p = 0.019$ ), compared to parents who did not have extra responsibilities. Younger parents and those not living with a spouse reported poorer outcomes. Parents who reported that they were taking on most of the child-caring responsibilities reported the poorest mental health, psychosocial well-being, and highest levels of loneliness. Psychosocial and community support for parents who take on schooling-at-home and education responsibilities is important for the well-being of the parents as well as for their children.

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**Keywords:** mental health, psychosocial well-being, loneliness, home-schooling, child-care, education

## 1. Introduction

Schooling-at-home has received recent social attention since the COVID-19 pandemic which resulted in abrupt changes in how people balance their work and family lives in their daily living. In work situations where possible, the mass population had switched to remote work from home. While working from home served to reduce virus transmission in society and protect individuals from getting infected, it reduced positive social interaction with peers and colleagues. Conversely, while those who continued to work in their regular workplace maintained access to positive social interaction, they were at higher risk of getting infected. Risk factors for reduced mental health and psychosocial well-being may therefore differ between the two groups of employed people. While social deprivation may have been more common among those working from home, stress, and fear of getting infected may have been more common among those still working in the regular workplace. However, a large study with data from 29 European countries showed that employees identified more advantages than disadvantages related to working from home (Ipsen et al., 2021).

Due to school closures to prevent the spread of infection, children switched to studying from home, which created extra schooling-at-home and child-care responsibilities for parents, who may or may not be working from home at the same time. In 2020, almost 90% of school students worldwide were experiencing the impact of nationwide school shutdowns, affecting over 1.5 billion children and young individuals (WHO, 2020). For parents working in their regular workplace, this may have caused concerns about children staying at home by themselves, or they may have needed to organize families and social support networks to care for their children while they were at work. For parents working from home, having children at home at the same time may have been a challenge for their work efficiency, while they also may have felt some gratification, being able to spend more time at home with their children (Ipsen et al., 2021). Before this study, parents reported increased negative emotions in their parenting role, such as anger or frustration and anxiety that interfered with their ability to parent during the height of the pandemic. Although most parents experienced no changes in parenting behaviours, some reported increased conflict, yelling and discipline (Kerr et al., 2021). How having additional child-care responsibilities related to parents' mental health and well-being during the pandemic crisis may also depend on other factors, such as the age of the parent or child, or whether a spouse, partner, or other family members were able to contribute to the child-care. A study conducted in China analyzing the relationship between fathers' mental health and spending more time with their young children showed less severe mental health symptoms when they engaged in more activities with their children (Wang et al., 2023). The increase in schooling-at-home duties during the COVID-19 pandemic provided an opportunity for research into its impact on society, including parental well-being.

The aim of the study was to examine differences in mental health, psychosocial well-being, and loneliness between parents with varying degrees of additional schooling-at-home and child-care responsibilities. In addition, we aimed to examine whether differences between these groups of parents were moderated by working-from-home status, living arrangements, and demographic variables.

## 2. Methods

### 2.1 Study design and setting

The multi-country study used a cross-sectional online survey design. The anonymous surveys were distributed through social media in Norway, the UK, the USA, and Australia in November 2020 through multiple online channels including Facebook, emails, and university newsletters and webpages. Participation was voluntary with no compensation for filling in the survey. A landing site for the survey was established at the researchers' universities; OsloMet University, Norway; University of Michigan, USA; Northumbria University, UK; and The University of Queensland, Australia. AØG led the overall project, and each country had a project lead. The survey was compiled by the researchers in two languages; Norwegian and English. Languages and cultural differences were considered during

the survey development process, meaning that the countries' phrasing of each item conveyed the same meaning when considering culturally embedded meanings of words and phrases.

The study was approved by OsloMet (20/03676) and the regional committees for medical and health research ethics (REK; ref. 132066) in Norway, reviewed by the University of Michigan Institutional Review Board for Health Sciences and Behavioural Sciences (IRB HSBS) and designated as exempt (HUM00180296) in USA, by Northumbria University Health Research Ethics (HSR1920-080) in UK, and (HSR1920-080 2020000956) by The University of Queensland Human Research Ethics Committee in Australia.

## 2.2 Participants

Participants were eligible to be included in the project if they were living in Norway, UK, USA, or Australia, understood Norwegian or English, were able to access the online survey, and were 18 years or older at the time of the survey. A total sample of 3,474 individuals (75.5% women; aged 18+; 18.8% Norway, 18.5% UK, 58.0% USA, 4.8% Australia) responded to the survey.

For the current analysis, participants were excluded if they had not responded to our main exposure variables of interest, namely parental ( $n = 71$  missing) and extra child-care status ( $n = 48$  missing). Missing data on these were low (3%) therefore their omission is unlikely to create substantial biases in our results. We further excluded 1,633 individuals who were not a parent because our study focused on parents only. Finally, our study included 1,722 parents who answered the parental and extra child-care status variables (see Figure 1).

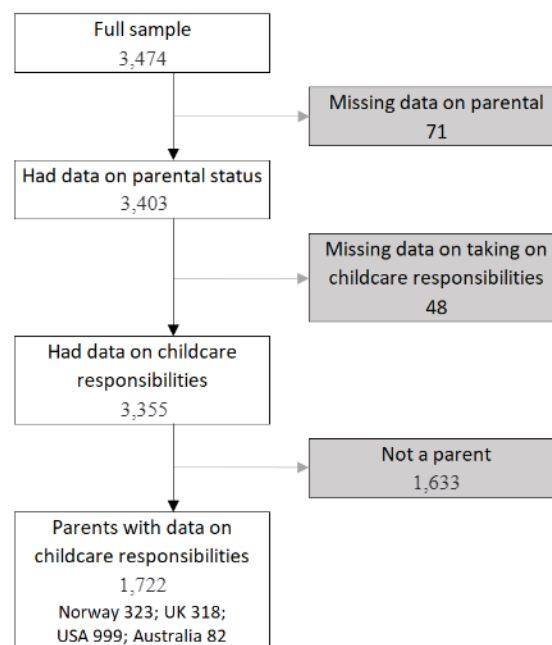


Figure 1. Flowchart of participant inclusion

## 2.3 Mental health (GHQ-12)

Mental health in the past 2 weeks was measured using the General Health Questionnaire 12 (GHQ-12) (Goldberg et al., 1997; Goodwin et al., 2013; Hankins, 2008). It is a widely used scale that has been validated across general adult, clinical, work and student populations (Aalto et al., 2012; Adlaf et al., 2001; Donath, 2001; Firth, 1986; Goodwin et al., 2013; Gorter et al., 2008; Malt, 1989; Nerdrum et al., 2006) and translated from English to several other languages, including Norwegian (Hystad & Johnsen, 2020; Malt et al., 1989). Six items are phrased positively (e.g. 'able to enjoy

day-to-day activities'), and six negatively (e.g. 'felt constantly under strain'). Responses are on a 4-point scale: 'less than usual' (0), 'as usual' (1), 'more than usual' (2) or 'much more than usual' (3). Scores range from 0-36 with higher scores indicative of poorer mental health.

## **2.4 Psychosocial well-being (PSW)**

Psychosocial well-being was measured using the 10-item Psychosocial well-being (PSW) scale which has been validated (Østertun Geirdal et al., 2021; Kaasa et al., 1988). The measure includes five positive and five negative statements. Summative scores are derived by calculating the mean scores of the 10 items, with the final scores ranging between 1 (highest well-being) and 5 (lowest well-being) (Kaasa et al., 1988).

## **2.5 Loneliness (LS)**

Loneliness was measured by the De Jong Gierveld Loneliness Scale (LS) (De Jong Gierveld & van Tilburg, 2006), which consists of six items. Responses are on a 4-point scale from 0 (totally disagree) to 4 (totally agree). Total scores range from 0-24 with higher scores indicative of higher levels of loneliness.

## **2.6 Child-care responsibility status**

Child-care responsibility status was derived from an item that asked, "If you have children, are you taking on additional home-schooling or child-caring responsibilities due to COVID-19?" Participants self-selected the category that they belong in, as 1) Parent, no extra child-care; 2) Parent, some extra child-care; 3) Parent, half of extra child-care; 4) Parent, most extra child-care.

## **2.7 Work arrangement status**

Participants reported on their current employment status and current work situation in a single item. Responses were categorised into: "Not in work", "Work primarily at home", "Work partly at home", or "Work primarily at workplace".

## **2.8 Living arrangement**

Living arrangement was measured by items that asked if they live with someone, and if yes, a tick list was provided for the selection of spouse/partner, child/children under 18 years, child/children over 18 years, grandchildren, parents/in-laws, or other. Participants could tick all that applied (yes/no for each option).

## **2.9 Demographic covariates**

Demographic covariates included country, gender, age group, and the highest level of education.

## **2.10 Statistical analysis**

Descriptive statistics and levels of missing data were examined. Missing data were imputed using multiple imputations ( $n = 5$ ) by using all variables of interest in this study as both the predictors and imputed variables. The imputation was conducted based on the multiple variable analysis method to address missing data, which analyses the patterns of missingness by the variables entered and can handle both categorical and continuous variables.

Generalised linear models were firstly fitted on each of the outcome variables of interest (GHQ, PSW, loneliness) with child-care responsibilities status as the explanatory variable, and all of the covariates entered. Effect sizes between groups were computed using Cohen's  $d$ . Secondly, interaction terms of parental and child-care responsibilities status were added with each of the other explanatory variables (working arrangement status, living arrangement, and demographic variables) to test for moderation effects. Tests of model effects were examined to identify the significance of interactions. Estimated marginal means of the outcome variables were presented.

### 3. Results

#### 3.1 Participant characteristics

Among the 1,722 parents included in this study, 41% were not in work at the time of the survey, and among those who were working, 26% and 11% worked at home primarily or partly, respectively (see Table 1). Most (77%) lived with their spouse and a minority (< 5%) lived with their grandchildren or in-laws. Our sample had more women (76%) and people with Bachelor's or higher education (71%).

There were 14.1% who reported some extra child-care, 5.9% who reported half of extra child-care, and 11.7% who reported that they took on most of the extra child-care or schooling-at-home responsibilities.

**Table 1.** Sample characteristics of parents (N = 1,722)

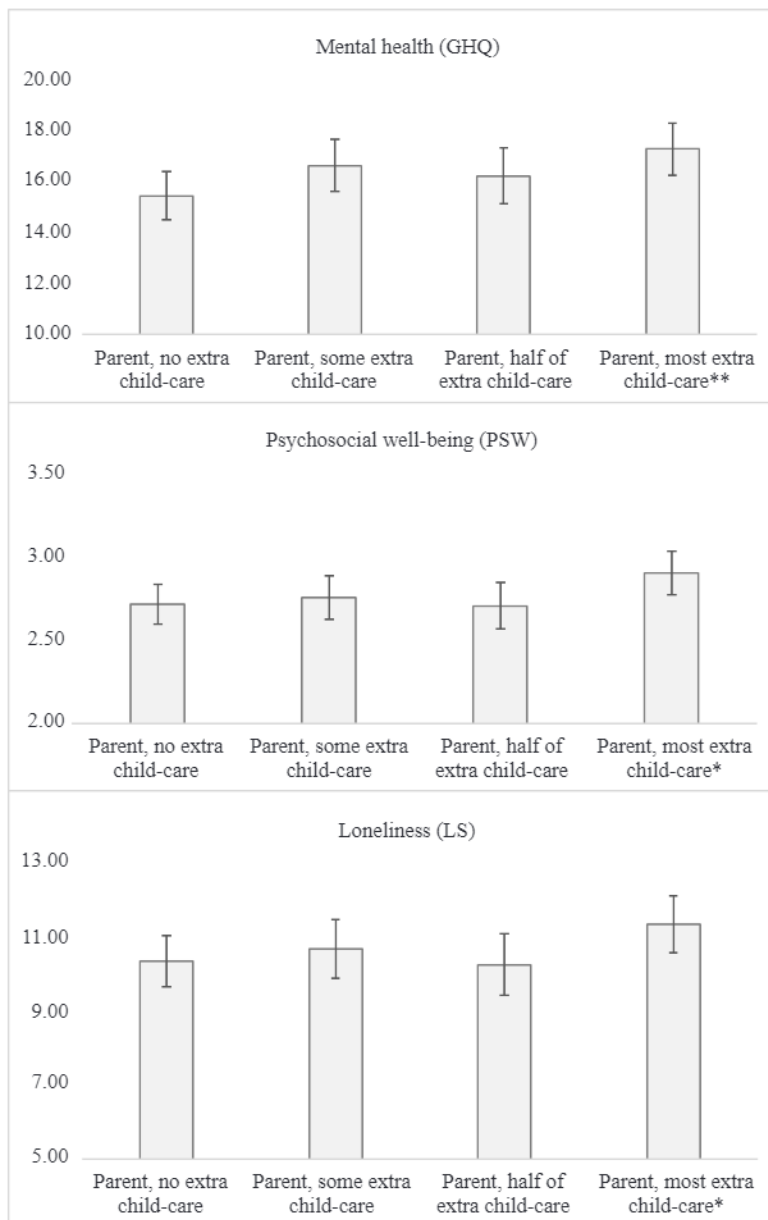
	Original data		Multiple imputed data	
	Mean	SD	Mean	SD
Mental well-being outcome variables				
Mental health (GHQ) <sup>a</sup>				
Mean, SD	15.41	6.58	15.44	6.59
<i>n missing</i>	106		--	
Psychosocial well-being (PSW) <sup>a</sup>				
Mean, SD	2.60	0.83	2.60	0.83
<i>n missing</i>	106		--	
Loneliness (LS) <sup>a</sup>				
Mean, SD	9.72	4.97	9.80	5.01
<i>n missing</i>	140		--	
	N	%	N	%
Parental child-care status				
Parent, no extra child-care	1,176	68.3%	1,176	68.3%
Parent, some extra child-care	243	14.1%	243	14.1%
Parent, half of extra child-care	101	5.9%	101	5.9%
Parent, most extra child-care	202	11.7%	202	11.7%
Remote work status				
Not in work	607	41.2%	701	40.7%
Work primarily at home	383	26.0%	463	26.9%
Work partly at home	159	10.8%	184	10.7%
Work primarily at workplace	324	22.0%	374	21.7%

<i>Missing</i>	240		--	
Living arrangement				
Spouse	1,332	77.4%	1,332	77.4%
Children under 18	592	34.4%	592	34.4%
Children over 18	236	13.7%	236	13.7%
Grand-children	25	1.5%	25	1.5%
Parents or in-laws	48	2.8%	48	2.8%
Others	37	2.1%	37	2.1%
Demographics				
Country				
Norway	323	18.8%	323	18.8%
UK	318	18.5%	318	18.5%
USA	999	58.0%	999	58.0%
Australia	82	4.8%	82	4.8%
Gender				
Men	390	22.7%	391	22.7%
Women	1,299	75.6%	1,301	75.5%
Other or prefer not to say	30	1.7%	31	1.8%
<i>Missing</i>	3		--	
Age group				
18-29	41	2.6%	45	2.6%
30-39	316	19.8%	346	20.1%
40-49	385	24.1%	417	24.2%
50+	856	53.6%	914	53.1%
<i>Missing</i>	124		--	
Education level				
Lower	500	29.1%	501	29.1%
Bachelors or higher	1,221	70.9%	1,221	70.9%
<i>Missing</i>	1		--	

<sup>a</sup>Higher scores are indicative of poorer outcomes

We had 6-8% of missing data for the GHQ, PSW and loneliness measures, 7% of missing data for age, and 15%

of missing data for work status and age. Analysis of missing data patterns indicated that the Norway sample was least likely to have missing data. Participants who were living with grandchildren were more likely to not report their age. Those who were living with parents or in-laws were more likely to have missing data on the mental well-being measures, remote work status, and age. The 18-29 age group were more likely to have missing data on work status. People who reported other or preferred not to say their gender were more likely to have missing data on the mental health, psychosocial well-being, and loneliness variables. Participant characteristics and distributions were similar after multiple imputations were applied to the missing data. Findings based on the multiple imputed datasets are presented below.



Note: Error bars are +/- 1 standard errors; \*p < 0.05, \*\*p < 0.01; higher scores are indicative of poorer outcomes. Effect sizes (most extra child-care vs no extra child-care) were d = 0.16 for GHQ, d = 0.14 for PSW, and d = 0.11 for LS

**Figure 2.** Estimated marginal means of mental health, psychosocial well-being and loneliness outcomes by child-care responsibilities status among parents (N = 1,722)

**Table 2.** Generalized linear models on mental health, psychosocial well-being and loneliness outcomes among parents (N = 1,722)

	Outcomes								
	Mental health <sup>a</sup>			Psychosocial well-being			Loneliness <sup>a</sup>		
	B	SE	p	B	SE	p	B	SE	p
Parental child-care status									
Parent, no extra child-care	ref			ref			ref		
Parent, some extra child-care	1.17	0.55	0.035	0.04	0.08	0.589	0.34	0.49	0.495
Parent, half of extra child-care	0.77	0.74	0.299	-0.01	0.09	0.914	-0.08	0.57	0.881
Parent, most extra child-care	<b>1.83</b>	<b>0.58</b>	<b>0.002</b>	<b>0.19</b>	<b>0.07</b>	<b>0.011</b>	<b>0.99</b>	<b>0.42</b>	<b>0.019</b>
Remote work status									
Not in work	0.98	0.51	0.062	<b>0.17</b>	<b>0.06</b>	<b>0.009</b>	<b>1.08</b>	<b>0.36</b>	<b>0.004</b>
Work primarily at home	0.64	0.48	0.184	0.10	0.06	0.101	0.49	0.36	0.170
Work partly at home	0.51	0.59	0.382	0.09	0.08	0.238	0.45	0.44	0.304
Work primarily at workplace	ref			ref			ref		
Living arrangement (ref: no) <sup>b</sup>									
Spouse	<b>-1.34</b>	<b>0.41</b>	<b>0.001</b>	<b>-0.32</b>	<b>0.05</b>	<b>&lt; 0.001</b>	<b>-2.20</b>	<b>0.32</b>	<b>&lt; 0.001</b>
Children under 18	0.37	0.42	0.371	0.10	0.05	0.064	<b>0.86</b>	<b>0.32</b>	<b>0.008</b>
Children over 18	0.16	0.51	0.755	0.02	0.06	0.736	-0.12	0.38	0.753
Grandchildren	1.38	1.45	0.343	-0.13	0.17	0.454	0.20	1.10	0.855
Parents or in-laws	-1.11	1.15	0.343	-0.07	0.14	0.635	-0.31	0.82	0.703
Demographics									
Country									
Norway	ref			ref			ref		
UK	<b>3.14</b>	<b>0.53</b>	<b>&lt; 0.001</b>	<b>0.39</b>	<b>0.07</b>	<b>&lt; 0.001</b>	<b>2.82</b>	<b>0.40</b>	<b>&lt; 0.001</b>
USA	<b>1.49</b>	<b>0.44</b>	<b>&lt; 0.001</b>	<b>0.16</b>	<b>0.05</b>	<b>0.003</b>	<b>2.51</b>	<b>0.33</b>	<b>&lt; 0.001</b>
Australia	0.42	0.81	0.605	0.10	0.10	0.301	1.76	0.60	0.003
Gender									
Men	ref			ref			ref		
Women	<b>2.17</b>	<b>0.39</b>	<b>&lt; 0.001</b>	<b>0.24</b>	<b>0.05</b>	<b>&lt; 0.001</b>	0.56	0.29	0.057
Other or prefer not to say	0.60	1.47	0.683	0.22	0.15	0.152	0.37	0.95	0.694
Age group									
18-29	<b>2.79</b>	<b>1.06</b>	<b>0.009</b>	<b>0.57</b>	<b>0.13</b>	<b>&lt; 0.001</b>	1.45	0.80	0.070
30-39	<b>1.74</b>	<b>0.54</b>	<b>0.002</b>	<b>0.29</b>	<b>0.07</b>	<b>&lt; 0.001</b>	0.80	0.40	0.050
40-49	<b>1.28</b>	<b>0.47</b>	<b>0.007</b>	<b>0.20</b>	<b>0.06</b>	<b>&lt; 0.001</b>	0.62	0.35	0.081
50+	ref			ref			ref		
Education level									
Lower	0.57	0.38	0.134	<b>0.17</b>	<b>0.05</b>	<b>&lt; 0.001</b>	<b>0.90</b>	<b>0.28</b>	<b>0.001</b>
Bachelor's or higher	ref			ref			ref		

Note: Significant associations at  $p < 0.05$  are bolded. <sup>a</sup>higher scores are indicative of poorer outcomes; <sup>b</sup>Each of the living arrangement variables were separate variables



### 3.2 Mental health, psychosocial well-being, and loneliness

Parents who were taking on most of the extra child-caring or schooling-at-home responsibilities consistently had significantly poorer mental health, psychosocial well-being, and loneliness, than parents with no extra child-care or schooling-at-home. The estimated marginal means after adjusting for all variables in the regression models are presented in Figure 2. The effect sizes (most extra child-care vs no extra child-care) were small ( $d = 0.16$  for GHQ mental health,  $d = 0.14$  for psychosocial well-being, and  $d = 0.11$  for loneliness).

Adjusted findings showed that parents who were living with their spouse had lower GHQ ( $B = -1.34$ ,  $p = 0.001$ ), PSW ( $B = -0.32$ ,  $p < 0.001$ ), and loneliness ( $B = -2.20$ ,  $p < 0.001$ ), indicative of better outcomes.

There were some significant differences by demographic variables. Compared to the Norwegian participants, participants in the UK and US samples reported poorer mental health, poorer psychosocial well-being, and higher levels of loneliness. Women reported poorer mental health and psychosocial well-being than men. Parents living with a spouse reported better mental health, better psychosocial well-being, and lower loneliness, but those living with children under 18 reported higher levels of loneliness. Parents who were not in work report higher levels of loneliness and poorer levels of psychological well-being. Younger parents reported the poorest mental health and poorer psychosocial well-being. Parents with lower education reported higher levels of poor psychosocial well-being and loneliness (see Table 2).

There were significant interactions of parental child-care status with living with a spouse on mental health, psychosocial well-being, and loneliness outcomes (Appendix, Table A1). Parents who took on most of the extra child-caring responsibilities who were not living with a spouse had especially poorer outcomes. The age of the children the parents were living with, living with grandchildren, age of the parents, and working from home or employment status did not significantly moderate the effects of taking on extra child-caring responsibilities on the outcomes.

## 4. Discussion

The main findings from this study showed that parents with extra schooling-at-home and childcare responsibilities during the COVID-19 pandemic have poorer mental health and wellbeing, as well as greater loneliness. Younger parents in this study experienced poorer mental health and psychosocial wellbeing than did older parents. Country of residence was also of importance for mental health, psychosocial well-being, and loneliness among the parents. Compared to parents in Norway and Australia, those in UK and USA experienced poorer mental health outcomes. Educational level was associated with psychosocial well-being and experience of loneliness among these parents. Those with lower education reported poorer outcomes. Parents might be feeling more stressed because they may be suddenly handling both regular parenting and educational roles at home. The abrupt additional educational responsibilities without any formal training could make parents feel overwhelmed and alone. This could be a mechanism underlying the lower mental well-being measures observed.

We found that younger parents reported poorer mental health and psychosocial well-being and more loneliness. Younger parents may be raising younger children, who may require more of the parent's time and focus due to the developmental needs of these children, compared to older parents who may be raising older children. It may also be that younger parents have fewer financial resources, which may contribute to higher stress, especially in the time of the COVID-19 pandemic (Thayer & Gildner, 2021). Financial stress may be associated with additional psychosocial problems. A recent study found that women who had less frequent contact with family and friends outside of the household during the pandemic and higher financial stress had a higher risk of domestic violence (Morgan & Boxall, 2020). Parental wellbeing has been highlighted as an important aspect because it impacts the parents' own lives as well as the wellbeing of the children, they are taking care of (Swigonski et al., 2021).

Our study highlighted that parents who took on most of the extra childcare responsibilities during the time of the COVID-19 pandemic were associated with, poorer mental health, lower levels of psychosocial well-being and increased loneliness, compared to parents who had no extra child-caring or schooling-at-home responsibilities. These findings are consistent with earlier studies and capture how increasing childcare responsibilities may limit parents' time to focus on self-care and engage in other life or job tasks. Zamarro and Prados showed that women had a higher burden of responsibility than men in the provision of childcare during the COVID-19 pandemic, and that women reported higher levels of mental distress during the pandemic (Zamarro & Prados, 2021). Our findings are in line with this, showing that women

have poorer mental health and psychological well-being than men. Differences among gender, with women showing poorer mental health, have been documented earlier, also during the COVID-19 pandemic (Østertun Geirdal et al., 2021; Pedraza et al., 2020; Zamarro & Prados, 2021). Our findings imply that psychosocial support for parents, especially mothers, with a high amount of burden related to childcaring and schooling-at-home duties is warranted.

For about half of the parents, the closure of schools and childcare settings did not add additional childcare work for them. This may include people who were not in work and who were already engaging in a high level of childcare activities, noting that in this study, almost half (41%) of the parents were not working. However, even for parents who were not working, the pandemic and additional stay-at-home policies may have created extra home duties. Indeed, we found that employment and working from home status did not moderate the relationship between taking on extra childcare and poorer mental wellbeing outcomes. Parents who reported that they took on most of the extra child-caring responsibilities during these times experienced poorer mental health outcomes, which did not differ by whether they were not working or working from home. Our findings add to those from a previous study that reported that even if many parents did not change their behaviours, some still reported increased family conflict (Kerr et al., 2021).

Another finding of interest from our study was that most of the parents in our sample had completed higher levels of education and were living with a partner/spouse. These factors appear to buffer against problems with mental health and overall well-being. The findings were observed after taking into consideration their additional childcare responsibilities. These findings are in line with former study results, both in general and during the pandemic (Bjelland et al., 2008; Bonsaksen et al., 2021; Geirdal et al., 2021; Østertun Geirdal et al., 2021). Considering our findings together with the existing literature, it is implied that poorer psychosocial wellbeing among single parents and those with lower education may be an ongoing social issue. Our findings highlight the need for targeted interventions and support systems for parents who may benefit from additional support with increased schooling-at-home and child-care demands. Understanding these specific challenges can guide the creation of resources and programs tailored to alleviate the associated mental and emotional strains.

While we advocate for more psychosocial support for parents, it is essential to acknowledge the roles that various stakeholders can play. The COVID-19 pandemic happened in a short time frame and there was limited capacity for rapid response. Governments can use observations from this pandemic for future planning. To be better prepared, government plans can be readied to include policies or subsidies that support parents, employers to offer flexible working hours, especially for parents, and schools could provide resources to help parents navigate schooling-at-home. Additionally, co-parents or spouses sharing responsibilities can alleviate the workload, and service providers can tailor their offerings to address pandemic-specific challenges. Each sector of the community can be better prepared to work together in supporting parents to navigate any potential future situations of unprecedented additional family responsibilities.

## 5. Limitations

Several key limitations need to be noted when interpreting the results of our study. First, this study was a cross-sectional study, therefore findings cannot be used to infer causation. It is unlikely however that parents with poorer mental health, psychosocial wellbeing, or loneliness could cause them to take on extra child-caring or schooling-at-home responsibilities. It may be possible that parents with poorer mental health may perceive the childcare demands to be more burdensome than parents with more positive mental health levels. In addition, our measures are based on self-report data, which are prone to potential biases. Future studies could consider including more objective measures of the extra parental responsibilities, such as specific additional tasks or measures of how much time were spent. In addition, future research could benefit from longitudinal designs and more diverse sampling to validate and expand upon our findings.

Secondly, compared to the general population, our sample had an over-representation of women and those over the age of 50 years with higher levels of education. The age distribution of the parents can be assumed to be associated with the age distribution of their children, hence more additional burden for the younger parents who were more likely to be taking care of the youngest children. It may also be that there are social differences between parents who had their child at an older age compared to parents who had their child at a younger age.

Further, the age of the children has implications for childcare responsibilities. We only asked if the parents

were living with children below or above 18 years of age. Our results about the association between extra parental responsibilities and mental health were consistent even if we excluded parents who were living with older children, except that the sample size was smaller. Differentiating only between children older/younger than 18 years is broad regarding differences in parents' caregiving burden. For example, parenting responsibilities for children in junior primary school differ a lot from those for children in senior high school. Older children are unlikely to require the same level of supervision, childcare, and educational support, and may have different psychosocial needs. The proportion of parents taking on extra child-care responsibilities may likely be higher in parents of younger children. Unfortunately, we did not collect data on the life stage of the children that the parents were taking care of. Due to our methods, we should not focus on the findings on the proportion of how many parents are reporting extra parental responsibilities, because our sample may not be representative of the general population and our findings do not provide information on parents for what age groups of children. Rather, we focus on the relationship between reporting extra parental responsibilities and mental health, which is the aim of our study and is the finding that is less susceptible to potential sampling bias. Future studies on parents' level of child-caring responsibilities could consider asking what age group the children belong to understand the effects of childcare responsibility among parents with children across different life stages.

It is also important to note that many of the older parents may not have had children under 18 years. Extra-childcaring or schooling-at-home responsibilities may not be relevant to parents with children who were over 18. Our main conclusions are unlikely to have been biased by this because we adjusted for the parent's age, as well as whether the parents lived with children under 18 or children over 18 years of age. We also adjusted for whether they lived with grandchildren, to adjust for those who may be taking on extra-childcaring or schooling-at-home responsibilities as a grandparent. Our results find that living with children under or over the age of 18, or whether they were living with their grandchildren, were not significantly associated with mental health, psychosocial wellbeing, or loneliness outcomes.

Our data was collected in November 2020, a time when each of the four countries was experiencing varied stages of the pandemic's impact. While the UK and the USA had witnessed high rates of COVID-19 morbidity and mortality, Australia had more variations by state and experienced less impact overall, and Norway was navigating its own unique set of challenges regarding restrictions and school closures. It is essential to interpret our findings within this variation in settings, recognizing the differing social and health contexts each country faced at that time. Therefore, we have adjusted for the country in which the participants were residing for our analyses on the relationship between parental child-care status and the well-being outcome measures.

A strength of our study is that we considered how much extra child-care responsibilities the parents had been taking on, instead of only relying on their parental status. We expected a dose-response effect of additional parental responsibilities on the mental health outcomes. We found that those who reported taking on most of the extra child-care responsibilities had the poorest outcomes. However, we did not find a dose-response trend of those who reported some or half of the extra child-care responsibilities. The response scale of "some" or "half" of the extra child-care responsibilities may be ambiguous. Future studies on the relationship between parental responsibilities and mental well-being factors should employ a participatory design framework to involve parents with lived experiences to contribute to the design of the study to provide insights into the wording of the items and any other potential additional important factors to measure.

## 6. Conclusions

Parents who reported taking on most of the child-caring and schooling-at-home responsibilities reported the poorest mental health, psychosocial wellbeing, and highest levels of loneliness. Psychosocial, governmental, and community support for parents taking on schooling-at-home responsibilities is needed because it is important for the wellbeing of the parents as well as for children growing up in the society.

## Conflict of interest

The authors declare that they have no conflict of interest.

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## Appendix

**Table A1.** Test of model effects of the interaction terms of the models on the mental health, psychosocial well-being and loneliness outcomes

	Mental health (GHQ)			Psychosocial well-being (PSW)			Loneliness (LS)		
	Wald Chi-square	df	p	Wald Chi-square	df	p	Wald Chi-square	df	p
Parental child-care status * Remote work status	12.00	12	0.468	12.91	12	0.388	17.32	12	0.142
Parental child-care status * Living with spouse	14.29	4	0.010	11.08	4	0.044	15.73	4	0.010
Parental child-care status * Living with children under 18	4.96	4	0.299	1.70	4	0.787	1.92	4	0.752
Parental child-care status * Living with children over 18	10.00	4	0.054	7.16	4	0.139	4.84	4	0.325
Parental child-care status * Living with grandchildren	1.11	3.2	0.812	2.98	3.2	0.439	1.31	3.2	0.760
Parental child-care status * Living with parents or in-laws	3.50	4	0.507	5.26	4	0.294	1.95	4	0.743
Parental child-care status * Country	16.65	11	0.127	14.87	11	0.199	14.01	11	0.270
Parental child-care status * Gender	13.62	8	0.128	13.78	8	0.090	6.20	8	0.625
Parental child-care status * Age group	19.45	12	0.093	15.50	12	0.216	12.96	12	0.374
Parental child-care status * Education	12.78	4	0.019	9.78	4	0.055	7.85	4	0.155