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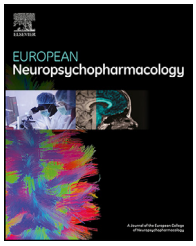

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The impact of the prolonged COVID-19 pandemic on stress resilience and mental health: A critical review across waves

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Abstract
The global public health crisis caused by COVID-19 has lasted longer than many of us would have hoped and expected. With its high uncertainty and limited control, the COVID-19 pandemic has undoubtedly asked a lot from all of us. One important central question is: how resilient have we proved in face of the unprecedented and prolonged coronavirus pandemic? There is a vast and rapidly growing literature that has examined the impact of the pandemic on mental health both on the shorter (2020) and longer (2021) term. This not only concerns pandemic-related effects on resilience in the general population, but also how the pandemic has challenged stress resilience and mental health outcomes across more specific vulnerable population groups: patients with a psychiatric disorder, COVID-19 diagnosed patients, health care workers, children and adolescents, pregnant women, and elderly people. It is challenging to keep up to date with, and interpret, this rapidly increasing scientific literature. In this review, we provide a critical overview on how the COVID-19 pandemic has impacted mental health and how human stress resilience has been shaped by the pandemic on the shorter and longer term. The vast literature is dominated by a wealth of data which are, however, not always of the highest quality and heavily depend on online and self-report surveys. Nevertheless, it appears that we have proven surprisingly resilient over time, with fast recovery from COVID-19 measures. Still, vulnerable groups such as adolescents and health care personnel that have been severely impacted by the COVID-19 pandemic do exist. Large interindividual differences exist, and for future pandemics there is a clear need to comprehensively and integratively assess resilience from the start to provide personalized help and interventions tailored to the specific needs for vulnerable groups.

Key messages

- The early stages of the COVID-19 pandemic were often associated with increased levels of distress and depressive and anxiety symptoms in the general population.
- A substantial group of individuals has been either largely unaffected or is even doing better during the pandemic.
- Longitudinal follow up showed remarkable signs of resilience.
- Health care workers appear to be at an increased risk of stress-related psychological symptoms.
- The mental health of children, adolescents, and students has been particularly affected by the pandemic.
- Elderly people are more vulnerable to the physical effects of COVID-19, but also report lower psychopathology during the pandemic.
- Individuals with an existing psychiatric disorder are experiencing detrimental impact on their mental health from the COVID-19 pandemic, but do not seem to have further increased symptom severity compared with their pre-pandemic levels.
- A high risk exists for psychiatric sequelae following a COVID-19 infection.
- Many methodological shortcomings occur in the current literature which is often cross-sectional and relies on self-report, and it is moreover hard to directly compare results across many of the studies.
- There is an urgent need for a personalized approach when it comes to identifying individuals at risk or resilient for the stressful effects of the COVID-19 pandemic.
- The effects of stress and the resilience capacity are dependent on (neuro)biological, psychological, and environmental factors and also are heavily dependent on an individual's unique context.

1. Introduction

In 2020 many of us had hoped that the COVID-19 pandemic would be over in 2021, and that normal life would have resumed. The situation is clearly different: the pandemic is still ongoing with novel and more contagious variants leading to increased infection rates across the globe, with consequently more stringent restrictions in social interactions and more lockdowns. By the spring of 2021, over 156 million confirmed cases and more than 3.2 million deaths of COVID-19 have been reported (https://covid19.who.int/), with health care systems worldwide being overburdened at certain times. As in 2020, summer was expected to be associated to a reduced impact of the pandemic. However, new variants of the virus emerged, such as the Delta variant and there is still concern for what will occur during fall and winter. The pandemic and the accompanying measures have led to changes in people's daily routines, limited social interactions, as well as formed tensions among families in lockdown together, and fear of getting ill and/or spreading the virus. At the same time, the prospect of mass vaccination efforts has given rise to hope. Undoubtedly, the pandemic has asked a lot from all of us given the high uncertainty and limited control over the situation. For mental health professionals, the key questions are: what are the effects of the COVID-19 pandemic on mental health, and what have we learnt from this unprecedented and prolonged pandemic regarding resilience at the individual and societal level? During the first wave of the pandemic, our Thematic Working Group on Resilience from the European College for Neuropsychopharmacology (ECNP) wrote an overview of stress resilience during the early stages of the pandemic (Vinkers et al., 2020). Now, almost a year later, there has been a second wave and, in many countries, a third wave. Numerous studies have attempted to identify how the stressful pandemic has impacted mental health in the shorter and longer term across a wide range of populations. In fact, by April 2021, a staggering 120,000 publications on COVID-19 had appeared, with over 5,000 dealing with the impact of the pandemic on mental health and how stress resilience is shaped during the prolonged COVID-19 pandemic. Given that the pandemic is continuing, and there is the risk of future outbreaks, it is timely to consider its impact on mental health and factors that are linked to resilience against mental illness to guide the ongoing response to it. In view of this, we aim to provide a critical overview of how the pandemic has affected mental health in general, and how human stress resilience has shaped its impact on the shorter and longer term. Moreover, we aim to summarize whether there are specific effects of the COVID-19 pandemic on stress resilience across groups that may be more vulnerable (such as health care workers and adolescents), and what we can learn for possible future pandemics. In this selective review, we did not apply a systematic approach but rather used a targeted Medline search strategy related to COVID-19 topics complemented with a thorough search of references in key publications. A general premise should be made in the interpretation of the results of this review as several caveats impact on the interpretation of the evidence here summarized. First, most of the studies were conducted in the first wave of the pandemic, often with limited duration of follow-up, and are based on cross-sectional assessments and online surveys. Secondly, and possibly more importantly, the impact of the pandemic (as measured in terms of infections and death rates) as well as lockdown measures varied significantly from country to country. However, although these methodological limitations could reduce the robustness of the findings as well as their comparability among different countries, we believe this data synthesis might guide the reader in interpreting the impact of the pandemic on mental health and the modulating role of resilience.

2. The general population

The pandemic has affected almost every individual directly or indirectly, either due to (or fear of) COVID-19 infection, or because of the effects of far-reaching measures and their economic and social impact. Consequently, the impact of the pandemic on mental health outcomes has been frequently examined in the general population. In a study conducted in April 2020, using a probability sample ($N = 1468$) and the Kessler-6 psychological distress scale (0–24 with 13 as a cutoff for serious distress), 13.6% of US adults reported symptoms of serious psychological distress, relative to 3.9% in 2018 (McGinty et al., 2020). In another study among 9565 individuals from 78 countries, during the height of the lockdown (April – June 2020), the pandemic was experienced as at least moderately stressful for most people, and 11% reported the highest levels of stress. Symptoms of depression were also high, including 25% of the sample indicating that the things they did were not reinforcing, 33% reporting high levels of boredom, and nearly 50% indicating they wasted a lot of time (Gloster et al., 2020). In a similar study which also used the Kessler-6 psychological distress scale ($N = 2555$), distress levels did not increase, with equal numbers of US adults experienced serious psychological distress in February 2019 (prior to the pandemic) as in May 2020 (Breslau et al., 2021). In the UK Household Longitudinal Study (UKHLS, $N = 17,452$), mental health was assessed with the 12-item General Health Questionnaire (GHQ-12) before and during the pandemic (Pierce et al., 2020). In this study, the population prevalence of clinically significant levels of mental distress rose from 19% in 2018–19 to 27% in April 2020 (1 month into the UK lockdown). In a later report on the UKHLS, most individuals had either consistently good (39% of the participants) or consistently very good (38%) mental health across the first 6 months of the pandemic (Pierce et al., 2021). A recovering group (12%) showed worsened mental health during the initial shock of the pandemic and then returned to pre-pandemic levels of mental health. The two remaining groups were characterized by poor mental health throughout the observation period, either with initial but sustained worsening in mental health (4%) or a steady and sustained decline in mental health over time (7%). Concerning major affective disorders, a nationally representative survey study of US adults (March – April 2020, $N = 1,441$) showed that the prevalence of depressive symptoms was more than three-fold higher during the COVID-19 pandemic when compared to the pre-pandemic prevalence (2017 – 2018) (Ettman et al., 2020). Indeed, a recent quantitative data synthesis, conducted by the Global Burden of Disease (GBD) Resource center, has shown that the

pandemic has impacted substantially on the risk of major depressive disorder and anxiety disorders, estimating an additional 53.2 million cases of major depressive disorder and an additional 76.2 million cases of anxiety disorders globally due to the COVID-19 pandemic (COVID-19 Mental Disorders Collaborators, 2021; Santomauro et al., 2021). Further support for the link between the COVID-19 pandemic and the onset of affective disturbances comes from the large cohort study of Lob et al. (March – April 2020, $N = 51,417$), showing that severe depressive symptoms were developed by 11% of their sample equaling 5656 participants, while moderate symptoms were experienced by 29% of the subjects during the COVID-19 pandemic (Iob et al., 2020a). In Italy ($N = 130$), quarantine resulted in increased internalizing symptoms, particularly in those individuals with pre-existing psychopathology or experiencing negative economic consequences (Castellini et al., 2021). In another study conducted in the US (March – June 2020, $N = 7138$), both increases and decreases in distress during the pandemic, assessed with the Patient Health Questionnaire-4 (PHQ-4), could be explained by perceived infection risk and risk of death, perceived financial risks, lifestyle changes resulting from the virus, perceived discrimination, and changes in substance use and employment status (explained variation: 70% for the increase in distress between March and April 2020, and 46% for the decline in April and June 2020) (Robinson and Daly, 2020). Among Chinese students ($N = 68,685$), levels of stress decreased after remission of the first outbreak (end of March – beginning of April), even though anxiety symptoms (22 to 26%) and depressive symptoms (11 to 15%) still increased, particularly in those with limited physical exercise and perceived social support (Li et al., 2021b). This indicates that the pandemic may have longer-lasting negative effects on mental health outcomes that might take time to fully emerge. Finally, a survey performed in 1,310 Spanish adults during the first lock-down period (March 2020) showed that regression models containing a series of variables (i.e. being female, having a younger age, having negative self-perceptions about aging, more time being exposed to news about COVID- 19, having more contact with relatives different to those that participants co-reside with) explained 48% and 33% of the variance of distress and loneliness respectively (Losada-Baltar et al., 2021). Although the methodological quality of studies was quite heterogeneous, with sometimes limited sample size, no longitudinal measures, and only sparse information about mental health status, adaptive responses after the first wave of the pandemic were frequently reported.

In contrast to studies showing increases in mental health problems in the general population, there is also convincing evidence that most individuals are sufficiently able to cope with the pandemic and its associated measures and even that increased resilience building in the general population may have occurred. In the Netherlands, for example, a longitudinal study among adults ($N = 3,983$) showed no apparent increase was found in anxiety and depression symptoms between March 2019 and March 2020 when the pandemic broke out (van der Velden et al., 2020). Moreover, in a Chinese general population study ($N = 1738$), which was conducted during the initial outbreak (end of January – beginning of February 2020) and the epidemic's peak four weeks later, there were no significant longitudinal changes in stress, anxiety and depression levels (Wang et al., 2020a). In Switzerland, a survey study ($N = 10,472$) documented increased stress in 50% of participants, but 24% showed no change and 26% even felt less stressed during the lockdown in April 2020 compared to the pre-pandemic period (https://osf.io/jqw6a/). More encouraging news stems from the UCL COVID-19 Social Study showing that, between March and August 2020, in over 36,500 adults, the highest levels of depression and anxiety occurred in the early stages of lockdown but declined fairly rapidly as individuals adapted to the changing circumstances, even though the sample is not representative of the national population (Fancourt et al., 2021). In Spain ($N = 3480$), after the confinement was lifted, depressive symptoms rapidly decreased after an initial increase during the confinement, but no clear effects on anxiety were found (Gonzalez-Sanguino et al., 2020). In Germany, worrying and depressive symptoms among the general population ($N = 2376$) decreased on average between March and June 2020 (Bendau et al., 2020b). Another US sample ($N = 7319$) found increased psychological distress (PHQ-4) between March and April 2020 as the COVID-19 crisis emerged and lockdown restrictions began, which subsequently declined to mid-March (baseline) levels by June 2020 (Daly and Robinson, 2020). In 1166 UK adults, a low-stable profile characterized by little-to-no psychological distress was the most common trajectory for both anxiety-depression and COVID-19-related PTSD (Shevlin et al., 2021). Assessment of loneliness in 1545 American adults in January, March, and April 2020 showed no significant changes in loneliness but rather increased perceived support from others (Luchetti et al., 2020).

Conclusion: In the general population, the early stages of the COVID-19 pandemic were often associated with increased levels of distress and depressive and anxiety symptoms. However, the effects of the pandemic on mental health in the general population have been quite heterogeneous from the beginning, and a substantial group has been either largely unaffected or is even doing better during the pandemic period. More importantly, longitudinal follow up has shown signs of resilience in the general population, with surprising ability to bounce back and adapt. For an overview of findings from cross-sectional and longitudinal studies on the impact of COVID-19 on stress resilience and mental health in the general population, see Table 1.

3. Health care personnel

Health care personnel have been particularly affected by the COVID-19 pandemic and exposed to more stressful circumstances than many other professional groups. This is due to several factors, including the increased infection risk, fear of infecting other people and being isolated from their families, working overtime, demanding work conditions with lengthy shifts, directly witnessing the suffering and death of patients, and witnessing the crowded and challenging situations in hospitals. Hence, it is not surprising that many studies on stress resilience and mental health outcomes during the COVID-19 pandemic have specifically focused on health care personnel. A meta-analysis of COVID-19-related stress and psychiatric symptoms in nurses al-

Table 1 The impact of COVID-19 on stress resilience and mental health in the general population.

Study	Population	Time period/ wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
McGinty et al., 2020	US Adults aged 18 years or older	April 7-13 2020	Cross-sectional,$N = 1468$	Psychological distress and loneliness among US adults in April 2020 (Johns Hopkins COVID-19 Civic Life and Public Health Survey) compared to the 2018 National Health Interview Survey (NHIS)	Unknown	3.9% of US adults reported psychological distress in 2018 compared to 13.6% in April 2020. In April 2020, 13.8% of US adults reported that they always or often felt lonely.
Gloster et al., 2020	Adults aged 18 years or older from 78 different countries	April 7 - June 7 2020,	Cross-sectional, $N = 9565$	The impact of COVID-19 pandemic associated lockdowns on mental health outcomes (stress (PSS), depression (MSBS) positive/negative affect (PANAS), wellbeing (MHC-SF))	Being at least 18 years of age and being able to read one of the 18 languages (English, Greek, German, French, Spanish, Turkish, Dutch, Latvian, Italian, Portuguese, Finnish, Slovenian, Polish, Romanian, Hong Kong, Hungarian, Montenegrin, & Persian)	The highest level of mental health difficulties were found in approximately 10% of the population. The pandemic was experienced moderately and highly stressful for 55.9% and 11% respectively. Symptoms of depression were high, with 25% reporting lack of reinforcement, 33% indicating boredom and nearly 50% indicating having wasted a lot of time.
Breslau et al., 2021	US adults aged 20 years or older	Two waves: T1 (February 2019; prior to pandemic) and T2 (May 2020; during pandemic)	Longitudinal, $N = 2555$	The impact of the COVID-19 pandemic by comparing psychological distress (Kessler-6) experienced during the pandemic with the highest level of distress respondents had experienced during a 12-month period prior to the pandemic	Unknown	In 12.8%, an increase in psychological distress was found during COVID-19 (T2) relative to the highest level of distress before COVID-19 (T1) (95% CI 9.9%-15.7%).The experience of severe distress before at T1 was a strong predictor for the experience of severe stress at T2..

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Table 1 (*continued*)

Study	Population	Time period/ wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
Pierce et al., 2020	UK people aged 16 years or older	April 23-30 2020; secondary analysis of the UK Household Longitudinal Study (UKHLS))	Longitudinal cohort, $N = 17,452$ (8.8% aged 16-24 years, 11.2% 25-34 years, 16.0% 35-44 years, 20.1% 45-54 years, 28.9% 55-69 years, 15.1% $\geq$ 70 years, 58.2% female, 80.4% white British, 4.5% non-white British, 1.6% mixed, 7.3% Asian, 2.2% black, 0.5% other ethnicity, 3.4% ethnicity missing)	Changes in adult mental health in the UK population before (using data from UKHLS) and during the lockdown.	Participation in either of the two most recent UKHLS data collections (Waves 8 or 9), being 16 years or older	The prevalence of clinically significant levels of mental distress was 27.3% (95% CI 26.3-28.2) in April 2020, compared to 18.9% (95% CI 17.8-20.0) in 2018-19. This increase in mental distress was higher than expected, given previous annual trends and particularly found in young people and in women.
Pierce et al., 2021	UK people aged 16 years or older	Late April - early October 2020), secondary analysis of the UK Household Longitudinal Study (UKHLS)	Longitudinal cohort, $N = 19,763$ (58.1% female)	Mental health trajectories during the COVID-19 pandemic and predictors of deterioration	Participation in either of the two most recent UKHLS data collections (Waves 8 or 9), being 16 years or older	Across the first 6 months of the COVID-19 pandemic up to October 2020, the mental health of most UK adults remained resilient (76.8%) or returned to pre-pandemic levels. (12.0%). For 4.1%there was an initial worsening in mental health that was sustained with highly elevated scores and 7.0% had little initial acute deterioration in their mental health, but reported a steady and sustained decline in mental health over time.
Ettman et al., 2020	US adults aged 18 or older	March 31, - April 13, 2020 ('during COVID-19 sample') and 2017-2018 ('pre-COVID-19 sample')	Cross-sectional, $N = 1441$ during COVID-19 (38.0% aged 18-39, 32.4% aged 40-59, 29.7% aged $\geq$ 60, 51.9% female) and $N = 5065$ pre-COVID-19 (37.8% aged 18-39, 34.2% aged 40-59, 28.0% aged $\geq$ 60, 51.4% female)	Prevalence of depression symptoms (PHQ-9) and factors associated with depression of US adults during vs before the COVID-19 pandemic	Being 18 years or older, speaking English, having completed an AmeriSpeak survey in the past 6 months	Prevalence of depressive symptoms was more than 3-fold higher during COVID-19 (8.5% before COVID-19 and 27.8% during COVID-19). Being exposed to more stressors and low income was associated with greater odds of depressive symptoms.

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Table 1 (*continued*)

Study	Population	Time period/ wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
Iob, E. et al., 2020	UK adults aged 18 or older	March 21- April 2, 2020	Cohort (part of longitudinal study of adults residing in the UK (the COVID-19 Social Study), $N = 51,417$ (mean age 48.8 years ($\pm$16.8), 51.1% female, 12.0% of Black, Asian, and minority racial/ethnic communities)	Severity of depressive symptoms (PHQ-9) over time among individuals at high risk in the UK during the COVID-19 pandemic	Having completed at least 1 interview of the COVID-19 Social Study	UK adults with low socioeconomic position (SEP) and with psychosocial and health-related risk factors were at heightened risk of experiencing moderate and severe depressive symptoms during the COVID-19 pandemic.
Castellini et al., 2021	Italian adults aged 18-60 years	Two waves: T0 (December 1 2019, - January 15 2020,; pre-lockdown) and T1 (April 22 - May 3 2020,; 1,5 month after the declaration of lockdown)	(Longitudinal and cross-sectional, $N = 671$ ($N = 130$longitudinal, $N = 541$ cross-sectional; 71.4% female, mean age women 33.1 years ($\pm$14.1), mean age men 35.0 years ($\pm$14.0),	The impact of the lockdown during the pandemic on mental health (BSI) by using a longitudinal (2 waves; T0 and T1) and a cross-sectional observation (T1).	Age between 18 and 60 years, having an Italian nationality, being a resident in Tuscany	Phobic anxiety (T0: 0.26 ± 0.43; T1: 0.48 ± 0.63; $p < 0.001$). and depressive symptoms (T0: 0.57 ± 0.48; T1: 0.73 ± 0.65; $p = 0.003$) increased during the lockdown as compared to a few weeks before the COVID-19 outbreak, whereas interpersonal sensitivity (T0: 0.58 ± 0.61; T1: 0.35 ± 0.61; $p < 0.001$) and paranoid ideation (T0: 0.49 ± 0.49; T1: 0.32 ± 0.49; $p < 0.001$) decreased.
Robinson & Daly, 2020	US adults aged 18 years or older	Six waves covering a period from March 10 -June 9 2020,	$N = 7138$ (34,125 observations, mean age 49.0 years ($\pm$16.5), 51.2% female)	Distress (PHQ-4) during the COVID-19 crisis and explanatory psychosocial and behavioural factors,	Being a participant in the Understanding America Study (UAS) and being 18 years or older	Personal health concerns, perceived financial risks and lifestyle changes increased and this accounted for a substantial amount of respectively 21% and 14–15% of the initial rise in distress. Reduction in personal health concerns, financial concerns, and changes in lifestyle all mediated the decrease in psychological distress.
Li, Y. et al., 2021	Chinese college students	Two waves; T1 (early phase of COVID-19 February 3–10 2020) and T2 ('under control' phase of COVID-19 March 24-April 3 2020,)	Longitudinal, $N = 68,685$ (T1 63.2% female, T2 62.6% female)	Trajectory changes of acute stress (IES-6), anxiety (GAD-7), and depressive symptoms (PHQ-9)	Being a student in one of the target universities (22 universities in Guangdong Province)	Rates of acute stress decreased over time (34.6% at T1 vs 16.4% at T2), while rates of probable depression (21.6% vs 26.3%) and anxiety (11.4% vs 14.7%) significantly increased.

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Table 1 (*continued*)

Study	Population	Time period/ wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
Losada-Baltar et al., 2021	Spanish adults aged 18 years or older	March 21-24 2020, after the mandatory lockdown which started on March 16 2020,	Cross-sectional, $N = 1310$ (mean age 42.36 years ($\pm$16.20), 71.1% female)	Loneliness and distress in people exposed to COVID-19 lock-down measures and explanatory personal and relational variables	Being older than 18 year, living in Spain and experiencing the required (mandatory) situation of lock-down at home	Being female, having a younger age, having negative self-perceptions about aging, more time being exposed to news about COVID- 19, having more contact with relatives (different to those that participants co-reside with) explained 48% and 33% of the variance of distress and loneliness respectively.
Van der Velden et al., 2020	Dutch adults aged 18 years or older	Four waves; T1 (November 2018, data from the longitudinal LISS panel), T2 (March 2019, data from the longitudinal VICTIMS study), T3 (November 2019, data from the longitudinal LISS panel), T4 (March 2020, longitudinal data from the VICTIMS study)	Longitudinal, $N = 3983$ (T1: 50.7% female, 26.7% aged 18-45, 23.6% aged 35-49, 25.9% aged 50-64, 23.8% aged $\geq$ 65; T2: not reported; T3: 50.7% female, 24.9% aged 18-45, 22.9% aged 35-49, 26.1% aged 50-64, 26.1% aged $\geq$ 65; T4: not reported)	Prevalence of high Anxiety and Depression Symptom (ADS) levels and lack of Emotional Support (ES) before the COVID-19 outbreak during the period in which the COVID-19 pandemic developed very rapidly in the Netherlands	Being older than 18 years	No significant differences in high ADS levels were found between November 2018 (16.7%) and March 2019 (16.8%) and between November 2019 (16.9%) and March 2020 (17.0%). For lack of ES, no significant differences were found between March 2019 (20.4%) and March 2020 (19.7%), although the total scores of lack of ES were significantly lower in March 2020 ($M = 10.2$, SD $= 3.41$) than in March 2019 ($M = 10.4$, SD $= 3.55$), $t(3982) = 3.50$, $p < 0.001$).
Wang, C. et al., 2020	Chinese general population (from 194 cities in China)	Two waves/surveys; T1 (January 31 - February 2, 2020), T2 (February 28 - March 1, 2020)	Longitudinal, $N = 1738$ with $N = 333$ participated in both waves (T1: 60.3% female, 53.1% aged 21.4-30.8 years; T2: 75.0% female, 46.5% aged 21.4-30.8 years)	Temporal psychological impact (IES-R) and adverse mental health status (DASS-21) during the initial outbreak and peak of COVID-19	Unknown	There were no significant longitudinal changes in mean DASS-stress (T1: $M = 7.76$, SD =7.74, T2: $M = 7.86$, SD), anxiety subscale (T1: $M = 6.16$, SD =6.57, T2: $M = 6.16$, SD =6.94) and depression scores subscale (T1: $M = 6.25$, SD $= 7.16$, T2: $M = 6.38$, SD =7.39) during the initial outbreak and the peak of the COVID-19 epidemic. The mean IES-R score of the second-survey respondents ($M = 30.76$, SD $= 16.34$) was significantly lower than the first-survey respondents ($M = 32.98$, SD $= 15.42$). .

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Table 1 (*continued*)

Study	Population	Time period/ wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
The Swiss Corona Stress Study, first wave (between April 6 and 8, 2020)(prep-print: https://osf.io/jqw6a/)	Swiss general population, aged 14 years and older	April 6 - 8, 2020, starting 3 weeks after the beginning of confinement	Cross-sectional, $N = 10,472$ (mean age 40.3 years ($\pm$ 13.6, 71% female)	The adaptation of the Swiss population to the COVID-19 outbreak and risk- and resilience factors	Living in Switzerland, being 14 years or older, having completed the survey by April 8 2020,	While 24.4% of the participants reported no change in stress levels, 49.6% of the participants reported an increase in stress levels during confinement as compared to the time before the COVID-19 pandemic.
Fancourt et al., 2021	UK adults, aged 18 years and older	March 23 (start of the first lockdown in the UK) - August 9, 2020	Prospective longitudinal observational, $N = 36,520$ (7.5% aged 18-29, 29.2% aged 30-45, 33.0% aged 46-59, 30.4% aged $\geq$ 60, 76% female)	Trajectories of anxiety and depression over the 20 weeks after lockdown was announced in England,	Having at least three repeated measures between March 23 and August 9, 2020	Anxiety and depression levels both declined across the first 20 weeks following the introduction of lockdown in England ($b = -1.93$, SE=0.26, $p < 0.0001$ for anxiety; $b = -2.52$, SE = 0.28, $p < 0.0001$ for depressive symptoms).
Gonzalez-Sanguino et al., 2020	Spanish adults	Three waves; T1 (March 21 - 29 2020), T2 (April 13 - 27 2020, during the hardest moments of the confinement with the greatest impact at the socioeconomic level) and T3 (May 21 - June 4 2020„ during initiation of de-escalation on the restrictive measures)	Longitudinal observational cohort, $N = 3480$ (T1: 35% aged 18-29 years, 59% aged 30-59 years, 6% aged $\geq$ 60 years, 75% female; T2: 29% aged 18-29 years, 64% aged 30-59 years, 7% aged $\geq$ 60 years, 81% female; T3: 27% aged 18-29 years, 65% aged 30-59 years, 8% aged $\geq$ 60 years, 81% female)	Effects of the pandemic and alarm situation on the mental health of the general population.	Being over 18 years of age, living in Spain, acceptance to participate in the successive evaluations of the study	Depressive symptoms increased significantly throughout the confinement ($Z(T0\text{-}T1) = 7.06$, $p < 0.001$, decreasing at the last assessment but not dropping to previous levels, with significant differences between the first and third evaluations ($Z(T0\text{-}T2) = 4.02$, $p < 0.001$).
Bendau, A. et al., 2020	German general population	Four waves; T1 (March 27 - April 6 2020„ during lockdown), T2 (April 24 - May 4 2020„ stepwise reduction of restrictive measures), T3 (May 15 - 35 2020) and T4 (June 6 - 15 2020, first cities introduce obligation of wearing face masks in public)	Longitudinal observational cohort, $N = 2376$ ($N = 503$ completed all four waves, mean age at T1 38.76 years ($\pm$ 12.01, 76.7% female)	Symptoms of (un-) specific anxiety and depression along different stages of the pandemic	Having an minimum age of 18 years, living in Germany, being able to complete the questionnaires in German, having participated in at least two waves of data collection	Specific COVID-19-related anxiety and the average daily amount of preoccupation with the pandemic decreased continuously over the four waves.

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Table 1 (*continued*)

Study	Population	Time period/ wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
Daly & Robinson, 2020	US adults, nationally representative data from eight waves of the Understanding America Study (UAS)	Eight waves; T1 (March 10–18 2020), T2 (April 1 - 14 2020), T3 (April 14 - 28 2020), T4 (April 29 - May 12 2020,), T5 (Mat 13 - 26 2020), T6 (May 27 - June 9 2020,), T7 (June 10 - 23 2020), T8 (June 24 - July 20 2020,)	Longitudinal observational cohort, $N = 7319$ (22.8% aged 18–34 years, 29.6% aged 35–49 years, 26.9% aged 50–64 years, 20.7% $\geq$ 65 years, 51.3% female)	Psychological distress following the emergence of the COVID-19 crisis in the United States	Unknown	On average psychological distress increased significantly by 0.27 standard deviations (95% CI [0.23,0.31], $p < .001$) from March 10–18 to April 1–14, 2020 as the COVID-19 crisis emerged and lockdown restrictions began in the US.
Shevlin et al., 2021	UK adults	Three waves; T1 (March 21 −28 2020, during first week of first UK lockdown), T2 (April 22 - May 1 2020„) and T3 (July 9 - 23 2020)	Longitudinal, $N = 2025$ at T1, $N = 1406$ at T2 and $N = 1166$ at T3	Clinically relevant levels of anxiety-depression (PHQ-ADS) and COVID-19 related PTSD (ITQ) over the first 4 months of the pandemic	Unknown	20.7% of the participants met the criteria for anxiety-depression at W1 with no significant change at W2 (18.6%) or W3 (20.0%). 16.8% of the participants met criteria for COVID-19 related PTSD at W1 and this percentage decreased to 15.8% at W2 and 14.4% at W3. The ITQ mean scores were similar at W1 ($M = 4.58$) and W2 ($M = 4.51$), but decreased at W3 ($M = 4.07$), with the mean at W3 being significantly lower than the mean at W1.
Luchetti et al., 2020	US adults	Three waves; T1 (January 31 - February 10 2020„ before the COVID-19 outbreak), T2 (March 18 - 29 2020, during the “15 Days to Slow the Spread” campaign) and T3 (April 23 - 29 2020, (during the “stay-at-home” policies of most states)	Longitudinal observational cohort, $N = 1545$ (mean age: 53.68 years ($\pm$ 15.63, 45% female)	Change in loneliness in response to the social restriction measures taken to control the coronavirus spread	Unknown	Despite some detrimental impact on vulnerable individuals, in the present sample, there was no large increase in loneliness across the three assessments ($d = 0.04$, $p > 0.05$) but remarkable resilience in response to COVID-19.

ready identified 93 studies published between January to September 2020 (Al Maqbali et al., 2021). In this meta-analysis, over one third of over 90,000 nurses reported stress, sleep disturbances and increased mood and anxiety symptoms. This seems considerably higher than findings from studies in nurses working during smaller-scale pandemics like SARS or when compared to the general population at the same time period (Chen et al., 2005). A similar picture arises from other studies. A survey of dental academics across 28 countries (March – May 2020, $N = 1862$) indicated considerable psychological impact of the COVID-19 pandemic with significantly increased worries and altered individual behavior (Ammar et al., 2020). Moreover, in a Spanish cohort of health care workers (April 2020, $N = 1422$) over half of the participants reported symptoms of post-traumatic stress disorder (PTSD) and anxiety disorders, and nearly 50% reported symptoms of depression, with women and younger people showing an even higher risk (Luceno-Moreno et al., 2020). A study of medical staff in China (February – March 2020, $N = 899$) indicated a significantly increased prevalence of psychiatric symptoms such as depression, anxiety and insomnia compared to the general population (Liang et al., 2020). A longitudinal study among Japanese adults (March 2020 and May 2020, $N = 1015$) showed that indices of fatigue, anxiety and depression increased among health care compared to non-health care workers during the COVID-19 outbreak (Sasaki et al., 2020). In Portugal, a cross-sectional study (May 2020) showed that physicians working at the frontline of COVID-19 ($N = 420$) presented worse mental health outcomes (anxiety, depression, stress and obsessive-compulsive symptoms) than other physicians. Moreover, this study found that being female and working at the frontline are risk factors for increased stress, while having a garden at home was a protective factor for anxiety and stress symptoms (Ferreira et al., 2021). In Turkey, when 939 health care workers were assessed cross-sectionally in April-May 2020, more than 60% of the participants reported anxiety and depression symptoms (Sahin et al., 2020). These studies stress the need for successful intervention or prevention strategies for health care personnel. To avoid long-term effects of stress, strategies to counteract the negative impact of the COVID-19 pandemic on mental health, particularly in highly affected populations, may be helpful. For instance, in a group of Italian general practitioners ($N = 102$), Di Monte and colleagues found that the implementation of task-orientated project management seemed protective against symptoms of burnout during the pandemic (Di Monte et al., 2020). In another study, specific pandemic-related stress factors were identified in health care personnel, including workload burden and fear of infection (Mosheva et al., 2020). Heath and colleagues reviewed several strategies to increase resilience among health care workers during and after the COVID-19 pandemic, also guided by the experiences of previous pandemics (Heath et al., 2020). They identified several interventions and approaches, ranging from individual strategies without professional help (e.g. increased self-care or mindfulness practice) to strategies implemented at the group or organizational level (e.g. competency / resilience training, availability of psychological first aid or implementation of effective leadership and organizational justice). Importantly, some of these intervention strategies, including computer-assisted resilience training, have already been developed and successfully tested (Aiello et al., 2011; Maunder et al., 2010; Weerkamp-Bartholomeus et al., 2020).

Conclusion: Overall, health care workers appear to be at an increased risk of stress-related psychological symptoms during a pandemic, compared to the general population. However, longitudinal studies are still largely lacking, and it remains to be seen whether the increase in symptoms is transient and can be considered a normal response to an abnormal temporally limited situation. For more solid conclusions, large-scale prospective longitudinal studies on the specific risk of health care personnel during and after a pandemic are needed. Such studies are already being planned (Roberts et al., 2020). This is particularly relevant as the COVID-19 pandemic has been present over a prolonged period and already spans several waves of infection. Importantly, specific prevention and intervention strategies at the individual as well as at the organizational level may be crucial, with studies already showing beneficial effects of these strategies. See Table 2 for an overview of findings from cross-sectional and longitudinal studies on the impact of COVID-19 on stress resilience and mental health in health care personnel.

4. Children, adolescents, and college students

It is plausible that the impact of the COVID-19 pandemic on mental health might vary as a function of age and levels of educational attainment. In this section, we present findings focusing first on the effects of the pandemic on mental health in children and their parents, and subsequently we discuss findings in studies performed in adolescents and college students.

4.1. Children and their parents

Due to measures to decrease the spread of the COVID-19 virus, schools have been closed and the opportunity to interact with peers, play outdoors and exercise decreased (de Lannoy et al., 2020; Moore et al., 2020), whereas sleep and screen time have increased (Orgiles et al., 2020). Parental stress significantly increased after the school closures (Hiraoka and Tomoda, 2020). Parents experienced financial and health problems and needed to comply with home schooling in addition to their own responsibilities, which affected parental routines. Parents' financial concerns increased verbal aggression, increased loneliness was associated with child neglect, whereas worries increased physical abuse of the children. In general, wellbeing of the parents significantly affected children's mental health (Carroll et al., 2020). A national survey from the US in June 2020 ($N = 1011$) reported worsening of mental health for 26.9% of the parents and 14.3% of the children, whereas the reported effect on physical health was smaller. Lost regular health care and delay in health care visits added to the worsening of children's mental health (Patrick et al., 2020). In Italy (April – May 2020, $N = 463$) (Cusinato et al., 2020) and in Spain (April 2020, $N = 1049$)

Table 2 The impact of COVID-19 on stress resilience and mental health in health care personnel.

Study	Population	Time period/ wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
Chen et al., 2005	Taiwanese female nurses	Mid-May 2003,(at the peak of the SARS outbreak)	Cross-sectional and case control, $N = 128$ (high risk group $N = 65$, mean age 27.2 years ($\pm$ 3.6), conscripted group $N = 21$, mean age 26.1 years ($\pm$ 2.9), control group $N = 42$, mean age 25.7 years ($\pm$ 2.2))	Symptoms of distress when working during the SARS crisis	Working as a nurse in the Kaohsiung Municipal Hsiao-Kang hospital during mid May 2003	11% of the nurses surveyed had stress reaction syndrome. Symptoms included anxiety, depression, hostility, and somatization. The highest rate of stress reaction syndrome was observed in the group that originally worked in a high-risk unit, and the conscripted group experienced the most severe distress on average..
Ammar et al., 2020	Adult dentists worldwide (28 countries)	March - May 2020	Cross-sectional, $N = 1862$ (27.8% aged 25–35 years, 32.9% aged >35–45 years, 20.2% aged >45–55 years, 13.7% aged >55–65 years, 5.4% >65 years, 53.4% female)	Psychological impact of COVID-19 on dental academics globally and on changes in their behaviours	Being a dental academic, training and/or educating dental student in a university or institution at the time of the study	COVID-19 had a considerable psychological impact on dental academics. There was a direct, dose-dependent association between change in behaviours (more frequent handwashing, avoiding crowded places) and worries but no association between these changes and training on public health emergencies.
Luceno-Moreno et al., 2020	Spanish adult healthcare workers	April 1 – 30 2020, during lockdown	Cross-sectional, $N = 1422$ (mean age 43.9 years ($\pm$10.8), 86.4% female)	Symptoms of posttraumatic stress, anxiety, depression, levels of burnout and resilience in Spanish health workers during the COVID-19 pandemic	Being a Spanish healthcare worker and being in contact with patients of COVID-19	56.6% of health workers presented symptoms of posttraumatic stress disorder, 58.6% anxiety disorder, 46% depressive disorder and 41.1% felt emotionally drained.
Liang et al., 2020	Chinese adult medical workers	February 14 - March 29 2020,	Cross-sectional, $N = 899$ frontline medical workers (1.9% aged $\leq$ 20 years, 67.5% aged 21–40, 30.4% aged 41–60, 0.2% aged >60, 81.3% female) and $N = 1104$ respondents in the general population (19.5% aged $\leq$ 20 years, 66.1% aged 21–40, 13.8% aged 41–60, 0.6% aged >60, 69.5% female)	Psychological symptoms in frontline medical workers during the COVID-19 epidemic in compared to the general population	Being a frontline medical worker during the COVID-19 pandemic	Overall, 30.43%, 20.29%, and 14.49% of frontline medical workers in Hubei Province and 23.13%, 13.14%, and 10.64% of frontline medical workers in other regions reported symptoms of depression, anxiety, and insomnia, respectively. In addition, 23.33%, 16.67%, and 6.67% of the general population in Hubei Province and 18.25%, 9.22%, and 7.17% of the general population in other regions reported symptoms of depression, anxiety, and insomnia, respectively..

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Table 2 (*continued*)

Study	Population	Time period/ wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
Sasaki, N. et al., 2020	Japanese adults (healthcare and non-healthcare workers)	Two waves; T1 (March 19 – 22 2020) and T2 (May 22 – 26 2020). OnApril 16, a state of national emergency was declared, which continued until 25 May	Longitudinal, $N = 1015$ with $N = 111$ healthcare (21.6% aged 20–29 years, 31.5% aged 30–39 years, 22.5% aged 40–49 years, 21.6% aged 50–59 years, 2.7% >60 years, 64.9% female) and $N = 904$ non-healthcare workers (17.8% aged 20–29 years, 27.2% aged 30–39 years, 26.3% aged 40–49 years, 26.8% aged 50–59 years, 1.9% >60 years, 47.8% female)	Longitudinal change in the mental health of healthcare and non-healthcare workers during two months of the COVID-19 outbreak in Japan	Being a Japanese full-time employee that had previously participated in a large digital marketing research survey	Psychological distress (and subscales of fatigue, anxiety, and depression) as well as fear and worry of COVID-19 increased statistically significantly more among healthcare than non-healthcare workers.
Ferreira et al., 2021	Portuguese physicians	May 4 - 25 2020	Cross-sectional, $N = 420$ ($N = 200$ in frontline group (mean age 47.0 years, 53.5% female) and $N = 220$ in the control group (mean age 60.0 years, 43.6% female)	Alterations in mental health status (depression, anxiety, stress measured with the DAS-21 and OCD symptoms, measured with OCI-R) of Portuguese physicians working at the COVID-19 frontline compared to those not working at the frontline	Being an active physician in Portugal	7.5% of physicians in the frontline group had severe depressive symptoms, compared to 4.5% of physicians in the control group. Regarding anxiety, 9.0% of physicians in the frontline group presented severe symptoms of anxiety compared to 5.9% of physicians in the control group. 11.5% of participants in the frontline group presented severe stress symptoms, compared to 4.4% in the control group. Being female and working at the frontline were found as potential risk factors for stress.
Sahin et al., 2020	Turkish healthcare workers	April 23 – May 23 2020,	Cross-sectional, $N = 939$ (11.5% aged 18–25 years, 36.1% aged 26–30 years, 29.4% aged 31–40 years, 23.0% aged >40 years, 66.0% female)	Prevalence of depression, anxiety, distress, and insomnia and related factors in healthcare workers during the COVID-19 pandemic in Turkey	Being a healthcare worker in Turkey between 23rd of April and 23rd of May 2020	729 (77.6%) participants exhibited depression, 565 (60.2%) anxiety, 473 (50.4%) insomnia, and 717 (76.4%) distress symptoms. Depression, anxiety, insomnia, and distress symptoms were significantly greater among females, individuals with a history of psychiatric illness, and individuals receiving psychiatric support during the COVID-19 pandemic.

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Table 2 (*continued*)

Study	Population	Time period/ wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
Di Monte et al., 2020	Italian general practitioners (GPs)	March 10 – May 18 2020,	Cross-sectional, $N = 102$ (mean age 55.1 years ($\pm$11.4), 62.7% female)	Dimensions of burnout and various psychological features among Italian general practitioners during the COVID-19 emergency	Being an active general practitioner in Italy between March 10th and May 18th 2020	The COVID-19 emergency had a significant impact on GPs' work Implementing task-oriented problem management, rather than emotional strategies, appears to protect against burnout in these circumstances.
Mosheva et al., 2020	Israeli physicians	March 19 – 22 2020	Cross-sectional, $N = 1106$ (mean age 46.1 years ($\pm$13.2), 49.0% female)	The association between pandemic-related stress factors (PRSF) and anxiety and the potential effect of resilience on anxiety	Being a physician in Israel in March 2020	Physicians reported high levels of anxiety with a mean score of 59.20 ± 7.95. An inverse association between resilience and anxiety was found. Four salient PRSF (mental exhaustion, anxiety about being infected, anxiety infecting family members, and sleep difficulties) positively associated with anxiety scores
Maunder et al., 2010	Canadian adult hospital workers	September 2008-January 2009	Cross-sectional, $N = 158$ (86% female)	Feasibility and effectiveness of an interactive, computer-assisted training course (short, medium and high version) designed to build resilience to the stresses of working during a pandemic	Being employee/professional staff member of the Mount Sinai Hospital in Toronto, Canada	Computer-assisted resilience training in healthcare workers appears to be of significant benefit and merits further study under pandemic conditions. Comparing three "doses" of the course suggested that the medium course was optimal.

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Table 2 (*continued*)

Study	Population	Time period/ wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
Aiello et al., 2011	Canadian adults	Unknown	Cross-sectional, $N = 1020$	Development, implementation, and results of resilience training in the Mount Sinai Hospital setting prior to the emergence of the H1N1 pandemic	Being a staff member of the Mount Sinai Hospital	The proportion of participants who felt better able to cope after the session (76%) was significantly higher than the proportion who felt prepared to deal confidently with the pandemic before the session (35%). Ten key themes emerged from a qualitative analysis of written comments, including family-work balance, antiviral prophylaxis, and mistrust or fear towards health care workers
Weerkamp-Bartholomeus et al., 2020	Dutch patients with stress-related complaints	Precise period unknown, but during lockdown	Non randomized, single-arm intervention, $N = 37$ (mean age 47.6 years ($\pm$18.7), 73% female)	Efficacy of remotely delivered 'Wiring Affect with ReAttach' (W.A.R.A.) in the reduction of negative affect and to compare the results with results of a previous study that investigated the efficacy of face-to-face W.A.R.A. in a cohort of 46 patients	Absence of suicidality risk and alcohol or drug abuse at the time of the online consultation	...

(Romero et al., 2020), parental stress was associated with more conduct problems of their children. In Hong Kong (March 2020, $N = 29{,}202$ families), children with special education needs, chronic illnesses, mothers with mental illness, and children coming from single-parent and low income families were reported as more vulnerable to the increased stress levels as a result of the pandemic (Tso et al., 2020). In Brazil (April - May 2020, $N = 289$), parents reported anxiety in 19.4% of their children. In particular, children living with a person other than their parents reported higher anxiety levels, especially when a guardian had a lower age and lower educational level (Garcia de Avila et al., 2020). Having a house without an outdoor exit to a garden or terrace significantly predicted psychiatric symptomatology (Francisco et al., 2020). Overall, there are concerns that the risk of child maltreatment might be heightened during the COVID-19 pandemic due to a range of stressors such as increased loneliness, reduced physical activity, economic stress, social distancing, homeschooling, marital conflicts and violence, and intensified child-parent relationships (Katz et al., 2020). In a recent study of 169 preschoolers, increased depressive and externalizing symptoms were observed compared to pre-COVID levels. A structured, predicable home environment adherent to family routines appears to mitigate these adverse effects (Glynn et al., 2021).

4.2. Adolescents

In adolescents, determinants of resilience are less related to the parental situation and stressors associated with parental stress. A large-scale cross-sectional study from China (during the COVID-19 outbreak, $N = 3613$) revealed that among 3254 adolescents, anxiety and depressive symptoms were common during the COVID-19 pandemic (Duan et al., 2020), as assessed by the Chinese version of the Spence Child Anxiety Scale (SCAS). In another cross-sectional study conducted in China (February – March 2020, $N = 1784$), following almost 30 days of confinement, depressive and anxiety symptoms were reported in around 23% of adolescents, with an association with less optimism about the pandemic and with being more worried about being infected with COVID-19 (Xie et al., 2020). A Swiss survey study (November 2020, during the second pandemic wave, $N = 11{,}612$) found that the youngest age group (14-24 years old, including students) were at higher risk for moderate-severe depressive symptoms (PHQ-9 $\geq$ 15) compared to individuals over 24 years old, and that this age-dependent effect became more prominent over the course of the pandemic (https://osf.io/6cseh/). A cross-sectional study from China (March -April 2020, $N = 7890$) reported a prevalence of 21.7% for anxiety and 24.6% for depression symptoms (HADS subscale score >7) (Li et al., 2021a). Another study from China (March 2020, $N = 8079$) revealed that the prevalence of mild to severe depressive symptoms was 43.7% (assessed by the PHQ-9) and anxiety symptoms were 37.4% (assessed by the GAD-7) (Zhou et al., 2020a). Being in senior high school (Zhou et al., 2020a), female gender (Zhou et al., 2020a) (Chen et al., 2020), lack of physical exercise (Chen et al., 2020), and less social support increased the risk for depressive and anxiety symptomatology (Qi et al., 2020). Furthermore, adverse childhood experiences, being exposed to COVID-19 and the presence of fear of exposure to COVID-19 were predictive of elevated levels of PTSD and anxiety in a Chinese cross-sectional cohort (February 2020, $N = 6196$) (Guo et al., 2020). Moreover, a longitudinal study among Australian adolescents ($N = 248$) showed that adolescents experienced significant increases in depressive and anxiety symptoms and a decrease in life satisfaction during the epidemic compared to 12 months leading up to the COVID-19 outbreak. COVID-19 related worries, online learning difficulties, and increased conflict with parents negatively affected the mental health outcomes, whereas adherence to lockdown measures and feeling socially connected during lockdown were protective factors (Magson et al., 2020). In Indonesia, decreased parental support was associated with total mental health difficulties, whereas anxiety due to the COVID-19 pandemic was associated with higher pro-social problems (April –May 2020, $N = 113$) (Wiguna et al., 2020).

The previous findings seem to imply that the effects of the COVID-19 pandemic were unanimously negative regarding stress, coping and mental outcomes. However, the literature is more nuanced. A longitudinal study from the US ($N = 322$) reported significantly lower internalizing, externalizing, and attention problems in adolescents during the lockdown (April 2020) compared to January 2020 (prior to the spread of COVID-19 in the US), which was associated with better family functioning in youth that reported elevated mental health problems before the pandemic (Penner et al., 2020). Even though a decrease in physical activity and an increase in sleep and screen time were reported for adolescents in a Chinese cross-sectional study (May 2020, $N = 10{,}082$) (Yang et al., 2020a), an Italian study (April 2020, $N = 306$) showed that the great majority of the adolescents did not notice or only noticed very little changes in psychological well-being in the early phase of the pandemic (Pigaiani et al., 2020). In Belgium and Italy (April - May 2020, $N = 825$), 5% of the participants reported having increased mental health care needs during the pandemic and 44% reported stability in needs for mental health care, with another 52% of the assessed youth reported no need for mental health care either before or after the pandemic (Marchini et al., 2020). A study from Japan focusing on monthly suicide rates of people younger than 20 years old (January – May 2020, $N = 138$), found that suicide rates from March 2020 to May 2020 slightly decreased during the school closure time and were not significantly different from the previous two years (Isumi et al., 2020). In Canada (March 2020, $N = 683$), almost half of a study sample of adolescents reported that the pandemic also exerted positive effects, with more time to spend with family and more time for exercise and hobbies. In addition, suicidal thoughts were reported to be lower than 6%. The type of motivation for social distancing was found to be associated with psychiatric symptomatology: social distancing due to fear of personally getting sick or to avoid judgement was related to higher anxiety, whereas social distancing due to the preference of staying home was associated with less anxiety and depressive symptoms (Oosterhoff et al., 2020).

4.3. College students

Among university students in Spain (March 2020, $N = 2530$), moderate to extremely severe levels of anxiety, depression, and stress were reported by 21%, 34%, and 28% of the participants, respectively (Odriozola-Gonzalez et al., 2020). In a Chinese cross-sectional study (February - March 2020, $N = 407$), the incidence of concerns about somatic symptoms, assessed by a somatic self-rating scale among college students, was 35%, mainly related to concerns regarding COVID-19 (Liu et al., 2020a). In Bangladesh (May 2020, $N = 476$), over 80% of students exhibited any form of (mild to severe) depressive and anxiety symptoms, also related to worrying about academic activities (Islam et al., 2020). In France (April - May 2020, $N = 69{,}054$), the prevalence of suicidal thoughts, severe depression, and high levels of anxiety were 11%, 16%, and 28%, respectively (Wathelet et al., 2020). In separate studies, female gender, social isolation, low quality of social relations were found as risk factors for lower mental health (Wathelet et al., 2020). In a US study (April 2020, $N = 195$), 71% of college students reported increased stress and anxiety, worry about their own and loved ones' health, sleep disruptions, difficulty with concentration, and concerns about academic performance as pandemic-related stressors (Son et al., 2020). For Chinese college students, 25% of the students reported mild to moderate anxiety when cross-sectionally assessed during the pandemic ($N = 7143$), with living in urban areas, income stability, social support, and living with parents as protective factors against anxiety (Cao et al., 2020). Worry about the economic influences of the pandemic, the academic delays and the influence of the pandemic on daily life also contributed to students' anxiety (Cao et al., 2020). In a Dutch study which ecologically followed students before and during the lockdown (March 2020, $N = 78$), mood homeostasis decreased significantly during lockdown, a finding that was in turn associated with lower mood and decreased engagement in activities that improved mood. Also, participants with previous mental illness showed a significantly higher decrease in mood homeostasis (Taquet et al., 2020). In Italy (March - April 2020, $N = 934$), students' concerns about the COVID-19 pandemic increased PTSD symptoms, whereas positive thoughts about managing the epidemic showed the opposite effect (Nania et al., 2020). Another longitudinal study conducted in the US ($N = 675$) showed that a group of college students reported a slight improvement in internalizing symptoms, but worsening of externalizing symptoms and attention when assessed before (beginning of Spring semester 2020) and during the pandemic (end of Spring semester 2020) (Copeland et al., 2021). Around 70% of a sample of 950 US students (March 2020) reported that using a coping strategy such as staying connected, trying to relax, keeping busy, having a day-to-day routine, hobbies, doing school work and exercising, were protective factors during the pandemic (Waselewski et al., 2020). A cohort from the Zurich Project on the Social Development from Childhood to Adulthood ($N = 768$) was assessed before the pandemic at the age of 20 and during the pandemic at the age of 22, and it was found that even though internalizing symptoms decreased, stress levels and anger increased during the pandemic. Moreover, only 30.5% reported feeling notably worse, whereas others were either feeling the same or better (Shanahan et al., 2020).

Conclusion: In general, the pandemic has had negative effects on the mental health of children, adolescents, and students. Nevertheless, the effects vary widely within and across groups, and there are many methodological shortcomings in the current literature which is often cross-sectional and relies on self-report. Moreover, it is difficult to directly compare results across many of the studies. In children and younger adolescents, parental stress and decreased physical activity seem to be important risk factors for worse mental health, but for adolescents and students, COVID-19-and academic related worries, familial conflicts, loneliness, and not engaging in health behaviors seem to be important risk factors. Although children, adolescent, and students seem particularly vulnerable for the negative effects of the pandemic in general, there are also some studies finding signs of resilience, such as the use of effective coping strategies. Findings from cross-sectional and longitudinal studies on the impact of COVID-19 on stress resilience and mental health in children, adolescents and college students are presented in Table 3.

5. Elderly people

Elderly people have been more directly affected by the pandemic than younger age groups as the physical impact of COVID-19 is substantially higher in this population. In addition, even though elderly people have higher levels of comorbidities that need to be taken care of, the availability of physician appointments and medical care has also been negatively impacted by the lockdown periods (Spalletta et al., 2020). In general, elderly people have lower access to technology and social media, which can make it more difficult to compensate for lockdown-related changes and have adequate access to food, news, and social interaction (Martins Van Jaarsveld, 2020). They are more isolated from their families and social connections, leading to an increased risk of developing psychiatric symptoms and therefore impairing their cognitive performance and daily functioning (Yang et al., 2020b). Elderly people also have been subject to change in health behaviors. A Cross-sectional study on the psychological, social and health-related challenges in Spanish older adults during the first COVID-19 wave (March 2020, $N = 528$) showed that while a quarter of the elderly people could increase their intellectual activity during the first lockdown, more than 60% of them reported decreased physical activity (Rodriguez-Gonzalez et al., 2020). In Greece, 80% of the elderly reported moderate to severe anxiety and depression levels three weeks after a national lockdown (March 2020, $N = 103$) (Parlapani et al., 2020), and these effects were also apparent in elderly with dementia in Argentina after the first 8 weeks of quarantine ($N = 119$) (Cohen et al., 2020). A German study (March - May 2020, $N = 15{,}308$) showed that while generalized anxiety significantly decreased with age, COVID-19 related fear significantly increased in elderly participants (Schweda et al., 2021), even though this was not found in other studies.

In contrast, despite all the challenges that the elderly population faces, lower rates of psychiatric symptoms in this population compared to younger age groups were re-

Table 3 The impact of COVID-19 on stress resilience and mental health in parents, children, adolescents, and college students.

Study	Population	Time period/ wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
Children and their parents						
Moore et al., 2020	Canadian children 5-17 years old	Precise period unknown, but during the initial period of the COVID-19 crisis	Cross-sectional, $N = 1472$ (mean age of age group 5-11 years = 8.12 (±2.04), mean age of age group 12-17 years = 14.85 (±1.68), 52.6% female)	The impact of COVID-19 restrictions on movement and play behaviours in children and youth (parent-reported)	Being a volunteer participant of the Manu/Matchbox consumer online database	There was a significant decline in all physical activities in both children and youth. The highest decline was observed in outdoor physical activity and sport. Leisure screen time and social media use was higher than before.
Orgiles et al., 2020	Italian and Spanish children 3 to 18 years old	Italy: March 25 - April 9 2020,, Spain: March 31 - April 15 2020,, data collection in both countries started 15 days after lockdown	Cross-sectional, $N = 1143$ (mean age 9.08 years (± 4.22), 47.5% female)	Emotional impact of the quarantine on children and adolescents from Italy and Spain (parent-reported)	Unknown	Children had more difficulty concentrating (76.6%), felt more bored than usual (52%), were more irritable (39%), were more restless (38.8%), were more nervous (38%), felt lonelier (31.3%), were more uneasy (30.4%), and more worried.
Hiraoka & Tomoda, 2020	Japanese parents of 0-18 year old children	April 29-30 2020, many children had remained at home from school from March 2 to at least until the end of April 2020	Cross-sectional, $N = 353$ (mean age 37.6 (±6.11), 78% female)	Qualitative structure of parenting stress	Unknown	Personal distress scores (Parenting Stress Index- Short Form) before school closures and after school closures were 2.39 (SD = 0.80) and 2.49 (SD = 0.72), respectively. Parents' current personal distress levels were significantly higher ($t = 4.89$, $P < 0.01$, $d = 0.12$) than before the school closures had occurred.
Carroll et al., 2020	Canadian families of young children	April 20 -May 15 2020,	Cross-sectional, $N = 235$ mothers and $N = 126$ father from 254 families (children's mean age = 6 years (±2.0), mothers' mean age = 37 years (±4.8), fathers' mean age = 39 years (±5.5))	Health behaviours, level of stress, financial and food security among Canadian families with young children.	Being a family with at least one child between 18 months and 5 years of age at the time of registration for the study, living within the Guelph-Wellington area in Ontario, being comfortable with English to respond to survey questionnaires	More than half the sample (mothers, 70%; fathers, 60%; children, 51%) stated their eating and meal routines has changed since COVID-19. Screen time increased among 74% of mothers, 61% of fathers, and 87% of children and physical activity decreased among 59% of mothers, 52% of fathers, and 52% of children

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Study	Population	Time period/ wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
Patrick et al., 2020	US parents and their children (aged < 18 years)	June 2020	Cross-sectional, N = 1011	Physical and emotional well-being of parents and children through early June 2020, using March 2020 as the reference point for the period before or at the beginning of the pandemic	Being a participating parent in the Ipsos KnowledgePanel and having at least 1 child aged <18 years old in the household	Compared to March 2020, 26.9% of parents reported worsening of mental health, 14.3% reported worsening in their children's behavioural health and 9.6% reported worsening of both their mental health and their children's behavioural health. Female and unmarried parents reported higher rates of worsening of their own mental health.
Cusinato et al., 2020	Italian parents of children aged 5–17 years	April 25 – May 8 2020,	Cross-sectional, *N* = 463 parents' (mean age = 43.4 years (±5.88), 90.5% female, children's mean age = 9.72 (±3.29, 43.8% female)	Potential risk and protective factors for parents' and children's well-being during a potentially traumatic event such as the COVID-19 quarantine	Having at least one child aged 5 to 17 years old living at home and having answered both child behavior questionnaires in their entirety	Confinement measures and changes in daily routine negatively affected parents' psychological dimensions, thus exposing children to a significant risk for their well-being.
Romero et al., 2020	Caregivers of Spanish children	April 2020 (precise period unknown, lockdown started on March 142,020 and on March 29, even more restrictive measures were imposed)	Cross-sectional, *N* = 1049 caregivers (data of *N* = 1123 children with a mean age of 7.26 years (±2.39), 50% female)	Effects of the Spanish confinement derived from the COVID-19 crisis on children and their families, accounting for child's age	Unknown	Preschool children showed a higher increase (38.2%) in conduct problems and hyperactivity as compared to their school-aged counterparts (20.3–24.4%). Child adjustment was influenced by a chain of effects, derived from parents' perceived distress and emotional response to the COVID-19 crisis, via parenting distress and specific parenting practices.

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Study	Population	Time period/ wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
Tso et al., 2020	Parents with 2-12 year old children from Hong Kong	March 2020 (precise period unknown)	Cross-sectional, $N = 29,202$ families ($N = 12,163$ parents with children aged 2-5 years and $N = 17,029$ parents with children aged 6-12 years. Mean age children 6.50 years (±2.84), 48.6% female	Characteristics of children vulnerable to the negative impacts of the COVID-19 pandemic factors that can promote psychosocial wellbeing within families during the COVID-1 pandemic (parent-reported)	Being a parent of a child aged 2-12 years	Compared to the reference means, children demonstrated significantly more psychosocial problems measured by the SDQ total difficulties score (12.79 (5.13) for age 2-5 and 11.59 (5.57) for age 6-12), fewer prosocial behaviours measured by the SDQ prosocial behavior score (6.19 (1.97) for age 2-5 and 6.49 (2.00) for age 6-12), and poorer functioning measured by PedsQL total score (79.83 (13.38) for age 2-5 and 79.67 (13.41) for age 6-12). Compared to the reference group, their parents exhibited higher levels of parenting stress measured by the PSS scale (48.88 (10.10) for age 2-5 and 49.72 (10.72) for age 6-12).
Garcia de Avila et al., 2020	Brazilian children aged 6-12 years and their guardians (mean age = 38.97 years (±6.54))	April 25 - May 25 2020,	Cross-sectional, $N = 289$ (157 girls and 132 boys, mean age 8.84 years (±2.05), 54.3% female	Prevalence of anxiety (Children's Anxiety Questionnaire; CAQ) among Brazilian children and its associated factors during social distancing during COVID-19 (parent-reported)	Unknown	The prevalence of anxiety among the children during the COVID-19 pandemic in this group was 19.4% ($n = 56$), according to the CAQ, and 21.8% ($n = 63$), according to the NRS. These results are higher than the prevalence reported for children under normal conditions (6.5%).
Francisco et al., 2020	Italian, Spanish and Portuguese children and adolescents aged 3-18 years old	15 days between March and April 2020 (precise period unknown)	Cross-sectional, $N = 1480$ children (mean age 9.15 years (±4.27), 47.2& female)	Immediate psychological and behavioural symptoms (anxiety, mood, sleep, behavioural, feeding, and cognitive alterations) associated with COVID-19 quarantine in children and adolescents, its explanatory factors and differences across countries (parent-reported)	Unknown	An increase in children's psychological and behavioural symptoms, increased screen-time, reduced physical activity, and more sleep hours/night was observed, with Portuguese and Spanish children presenting more psychological and behavioural symptoms compared with Italian children. Having an outdoor exit in the house was associated with lower levels of psychological and behavioural symptomatology.

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Study	Population	Time period/ wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
Glynn et al., 2021	US Mother-child pairs of preschool children in Southern California	May 5 2020, (On March 19 2020,, a state-wide stay at home order was issued which was in place until May 8 2020,)	Cross-sectional, $N = 169$ children (mean age 4.1 years ($\pm$0.93, 46.7% female)	Mental health symptoms in American preschool children during the COVID-19 pandemic (parent-reported))	Having completed the survey by June 9, 2020	39.9% of the children scored above the recommended cut-off ($\geq$3) for referral for further evaluation for clinical depression. The proportion of children scoring above the cut-off was elevated compared to those reported in a pre-COVID German population-based sample (5.7%; Fuhrmann et al., 2014) and more similar to a pre-COVID high risk US sample enriched for depression (43.7%); Luby et al., 2012).
Adolescents						
Duan et al., 2020	Chinese children and adolescents	During the COVID-19 outbreak (precise period unknown)	Cross-sectional, $N = 3613$ (9.9% aged 7-12 years, 90.1% aged 13-18 years, 49.9% female)	Psychological effects on children and adolescents associated with the early phase of COVID-19 pandemic	Being in high school (grade one to grade three; aged 7-18 years) in mainland China	Findings indicate that the COVID-19 outbreak has had a significant psychosocial impact on children and adolescents. 22.28% was suffering from depressive symptoms and levels of anxiety in children and adolescents during the epidemic were much higher than before the pandemic.
Xie et al., 2020	Chinese children	February 28 - March 5 2020,, participants had been restricted to home for a mean (SD) of 33.7 (2.1) days when completing the survey	Cross-sectional, $N = 1784$ (43.3% female)	Depressive and anxiety symptoms among adolescents in Hubei province, China	Being in primary school (grade 2 through 6) in Hubei province	22.6% and 18.9% of adolescents reported having depressive symptoms and anxiety symptoms, respectively.
Li, W. et al., 2021	Chinese high school students	March 30 - April 7 2020, (quarantine was imposed in Wuhan from January 23, 2020, to April 8, 2020)	Cross-sectional, $N = 7890$ (37.6% aged 12-14 years, 35.1% aged 15-16 years, 27.2% aged 17-18 years, 52.1% female)	Prevalence of depression and anxiety and their associations with lifestyle changes among adolescents in Wuhan	Being a current resident in Wuhan, aged 12-18 years old, not having a diagnosis of COVID-19	During the COVID-19 quarantine period, more than 20% of adolescents had anxiety and depression. The prevalence was 21.7% (n = 1708) for anxiety and 24.6% (n = 1941) for depression.

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Study	Population	Time period/ wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
The Swiss Corona Stress Study: second pandemic wave, November 2020 (pre-print: https://osf.io/6cseh/)	General Swiss population aged ≥14 years	November 11-19 2020 (during the second pandemic wave)	Cross-sectional, $N = 11,612$ (mean age 39.3 years (±13.4), 73.8% female)	Stress levels and depressive symptoms (PHQ-9) in comparison to the first survey during lockdown in April 2020	Living in Switzerland, being ≥14 years	While the proportion of people reporting maximum stress levels was around 11% during the April lockdown, it rose to 20% in the second pandemic wave in November. The proportion of respondents with moderately severe or severe depressive symptoms was 3% before the pandemic, 9% during the April lockdown, and 12% during May, it increased to 18% in November.
Zhou, S. J. et al., 2020	Chinese adolescents	March 8 - 15 2020	Cross-sectional, $N = 8079$ (median age 16 years, 53.5% female)	Prevalence rate and socio-demographic correlates of depressive and anxiety symptoms	Having an age of 12-18 years	The prevalence of depressive symptoms, anxiety symptoms, and a combination of depressive and anxiety symptoms was 43.7%, 37.4%, and 31.3%, respectively, among Chinese high school students during the COVID-19 outbreak.
Chen et al., 2020	Chinese children and adolescents	April 16 - 23 2020	Cross-sectional, $N = 1109$ ($n = 343$ aged 6-8 years, $n = 310$ ages 9-12 years, $n = 353$ 13-15 years, 45.5% female)	Prevalence of depression and anxiety among Chinese children and adolescents	Unknown	112 (11.78%) adolescents with depression, 196 (18.92%) adolescents with anxiety, and 68 (6.56%) adolescents with both depression and anxiety were identified.
Qi et al., 2020	Chinese adolescents	March 8 - 15 2020	Cross-sectional, $N = 7202$ (median age 16.0 years (interquartile range [IQR] = 2.0, range 14.0-18.0), 53.6% female)	The association between the levels of social support and mental health) among Chinese adolescents	Being a junior high school or senior high school student, being a WeChat or QQ user, having submitted only one survey using the same IP address	COVID-19 exposure was associated with a higher prevalence of depression symptoms (OR = 1.38, 95% CI: 1.14-1.66) and anxiety symptoms (OR = 1.26, 95% CI: 1.04-1.52). Only 24.6% of adolescents reported high levels of social support.
Guo et al., 2020	Chinese adolescents	February 8 −27 2020	Cross-sectional, $N = 6196$ (age range 11-18 years, 52.10% female)	Levels of anxiety and post-traumatic stress symptoms and whether pre-pandemic maltreatment experiences exacerbate this impact on mental health in adolescents	Being a student at one of the selected high school and middle schools in Zhenping County of Henan Province	Exposure to COVID-19 predicted higher levels of PTSS and anxiety with effect sizes ranging from 0.06 to 0.15 (standardized betas). The largest variance in PTSS and anxiety problems was explained by adverse childhood events (ACEs), with more pre-pandemic maltreatment experiences predicting more PTSS and more anxiety.

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Study	Population	Time period/ wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
Magson et al., 2020	Australian adolescents	Two waves; T1 (12 months leading up to the COVID-19 outbreak) and T2 (two months following the implementation of government restrictions and online learning).	Longitudinal, $N = 248$ (mean age 14.4 years ($\pm$ 0.5), 51% female, 81.8% Caucasian)	The impact of the COVID-19 pandemic on adolescents' mental health	Being part of the larger longitudinal Risks to Adolescent Wellbeing Project (the RAW Project)	Significant increases in adolescents' symptoms of depression, ($t(1, 247) = 6.26$, $p < 0.001$, $d = 0.15$), and anxiety, ($t(1, 244) = 5.26$, $p < 0.001$, $d = 0.40$), and a significant decrease in life satisfaction, ($t(1, 244) = -5.26$, $p < 0.001$, $d = 0.61$) from T1 (before the pandemic) to T2 (2 months into the pandemic) was observed.
Wiguna et al., 2020	Indonesian adolescents	April 15 - May 10 2020,	Cross-sectional, $N = 113$ mean age 14.07 years ($\pm$2.18), 46.9% female)	Behavioural and emotional problems during the pandemic	Being a family with at least one child of 11–17 years old, informed consent by parents and child	10.6% of the participating adolescents were at risk for emotional problems, 15.0% for conduct behavior, 38.1% for peer-relationship problems, 8% for hyperactivity behavior, and 28.3% for pro-social behavior problems.
Penner et al., 2020	US adolescents	Baseline measure (January 2020, prior to the spread of COVID-19 in the United States) and follow-up measures (mid-April 2020, 1 Month After School In-Person Closure)	Longitudinal, $N = 322$ (mean age 11.99 years ($\pm$ 1.16), 55.0% female, 72.7% Hispanic/Latin, 9.3% = Black or African American, 5.9% Multiple Races, 5.0% Asian, 1.6% White, 1.2% American Indian, and 4.3% 'other'	Longitudinal change in mental health before and during the pandemic	Being a public school student (grade 5–8)	For adolescents who had elevated levels of internalizing, attention, externalizing, or total problems before the pandemic, a significant reduction in mental health problems from baseline to follow-up measures was observed, controlling for age and gender.
Yang, S. et al., 2020	Chinese adolescents	Early May 2020 (precise period unknown)	Cross-sectional, $N = 10{,}082$ (mean age 17.5 years ($\pm$1.2), 71.7% female)	The impact of the pandemic on obesity, weight, BMI and activity patterns among youth	Unknown	During the COVID-19 lockdown, the prevalence of overweight/obesity and obesity significantly increased in all participating adolescents and significant changes were observed in patterns of all forms of physical activity, with more adolescents having increased their sedentary, sleeping, and screen time.

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Study	Population	Time period/ wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
Pigaiani et al., 2020	Italian adolescents	April 1 – 10 2020	Cross-sectional, $N = 306$ (mean age 18.1 years (±0.9), 27.1% female)	Lifestyle behaviours, coping strategies and well-being among Italian adolescents	Being 18 years or older, being a student at one of the three participating high schools located in Verona, Milan and Rome	Although most students (50.7%))did not report or reported only a little change in subjective well-being, 49.4% and 39.9% reported a change in subjective well-being and symptoms of anxiety respectively. Factors predicting a change in subjective wellbeing included adaptive coping strategies (physical activity, engaging in different activities than before), family issues (finding hard to stay at home, having quarrels), school-related behaviours (fearing a negative educational outcome) and female gender.
Marchini et al., 2020	Italian, Belgian adolescents	April 7 - May 4 2020, (just after the enactment of lockdown measures in Italy (March 9) and Belgium (March 18))	Cross-sectional, $N = 825$ (median age 20 years (IQR 20–24 years), 74.7% female, 53.7% living in Belgium, 46.3% living in Italy)	The relationship between resilience and loneliness and the emergence of new or increased mental health care needs (MHCNs) during lockdown measures	Speaking French or Italian, being a resident in Belgium or Italy	More loneliness, and lower resilience was observed in youth who needed help prior/during lockdown.
Isumi et al., 2020	Japanese adolescents	January 2018 - May 2020	Cross-sectional, $N = 138$	Suicide rates per month between January 2018 and May 2020 from public data on suicide statistics compiled by the Ministry of Health, Labor and Welfare	Being younger than 20 years old	During the school closure due to the COVID-19 crisis (March to May 2020), no significant change of suicide rates was found (incidence rate ratio (IRR) =1.15, 95% confidence interval (CI): 0.81 to 1.64), compared with the same months in 2018 and 2019.

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Study	Population	Time period/ wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
Oosterhoff, B. et al., 2020	US adolescents	March 29–30 2020 (two weeks after COVID-19 was declared a national emergency in the US)	Cross-sectional, $N = 683$ (mean age 16.35 years ($\pm$1.13), 75.3% female, 77.0% white/Caucasian, 15.5% Hispanic/Latino, 5.6% African-American/Black, 11.2% Asian American/Pacific Islander, 3.2% American Indian/Alaskan Native, 2.9% other	Connections between social distancing motivation, anxiety and depressive symptoms and social health (belongingness and burdensomeness)	Being 13 – 18 years old	Almost all respondents (98.1%) reported engaging in at least a little social distancing. No evidence of an association between degree of social distancing engagement and any indicator of mental or social health was found.
College students						
Odriozola-Gonzalez et al., 2020	Spanish university members	March 28 – April 4 2020, (during the first days of confinement	Cross-sectional, $N = 3707$ (mean age 27.9 years ($\pm$12.4), 66,1% female, 76.8% students)	The emotional impact of COVID-19 in the university community, using the Depression Anxiety Stress Scale (DASS-21) and the Impact of Event Scale (IES)	Being a university member living in Spain	50.43% of the participating university members reported moderate to severe emotional impact of the COVID-19 outbreak 21.34%, 34.19% and 28.14% of the respondents reported moderate to extremely severe scores of anxiety, depression and stress, respectively.
Liu, S., et al., 2020	Chinese primary and university students	February - March 2020 (precise period unknown)	Cross-sectional, $N = 407$ ($N = 209$ primary school, $N = 198$ college, 60.4% female)	The impact of the COVID -19 pandemic on primary and university students	Being a university or primary school student in Sichuan Province	Somatic symptoms were observed in 34.85% of the college students and in 2.39% of the primary school students. Somatic symptoms were associated with concerns about COVID-19.
Islam et al., 2020	Bangladeshi university students	May 6 – 12 2020 (all education institutions were closed initially from March 18 to March 31, 2020 and later extended to the mid of June 2020 in phases)	Cross-sectional, $N = 476$ (24.2% aged 17–20 years, 67% aged 21–24 years, 8.8% aged $>$24 years, 32,8% female))	The prevalence of depression and anxiety of university students in Bangladesh	Being a university student	During the ongoing COVID-19 pandemic, a large percentage of Bangladeshi university students have been suffering from depression and anxiety symptoms with 82.4% of the students reported to have mild to severe depressive symptoms and 87.7% reported to have mild to severe anxiety symptoms.

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Study	Population	Time period/ wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
Wathelet et al., 2020	French university students	April 17 2020, - unknown	Cross-sectional, $N = 69,054$ (median age 20 years (IQR 18–22 years), 72,8% female)	The prevalence of self-reported suicidal thoughts and symptoms of distress, stress, depression, and anxiety in university students during the COVID-19 pandemic.	Being a university student	Prevalence rates were 11.4%, for suicidal thoughts, 22.4%, for severe distress, 24.7%, for high levels of perceived stress, 16.1% for severe depression, and 27.5% for high levels of anxiety. Factors associated with all mental health issues were having a low level of physical activity, not living with family, having a weak sense of integration, having a low quality of social relations, and receiving low-quality information.
Son et al., 2020	US undergraduate students	One month after the stay-at-home order in April 2020 (precise period unknown)	Cross-sectional, $N = 195$ (mean age = 20.7 years ($\pm$ 1.7), 56,9% female)	The impact of the pandemic on the mental health of college students (general stress, depressive and suicidal thoughts)	Being a undergraduate student	71% of the students reported that their stress and anxiety had increased due to the COVID-19 pandemic, 91% indicated that the pandemic increased the level of fear and worry about their own health and the health of their loved ones, 86% reported disruptions to their sleep patterns caused by the COVID-19 pandemic, 44% mentioned having experiencing some depressive thoughts during the COVID-19 pandemic, and 8% stated that the pandemic has led to some suicidal thoughts.
Cao et al., 2020	Chinese college students	During the COVID-19 outbreak (precise period unknown)	Cross-sectional, $N = 7143$ (69.65% female)	The impact of the pandemic on the mental health of college students	Being a college student	24.9% of college students experienced COVID-19 related anxiety. Living in urban areas (OR= 0.810, 95% CI = 0.709 - 0.925), stability of students' family income (OR= 0.726, 95% CI = 0.645 - 0.817), and living with parents (OR= 0.752, 95% CI = 0.596 - 0.950) were protective factor against anxiety.
Taquet et al., 2020	Dutch students	March 16 – 29 2020 (ecological momentary assessment 4 times every day)	Longitudinal, $N = 78$ (mean age 20.4 years ($\pm$ 3.7), 76% female)	Mood homeostasis	Being a student	Mood homeostasis was significantly higher before than during lockdown with mood homeostasis decreasing significantly more among people with vs without a history of mental illness.

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Study	Population	Time period/ wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
Nania et al., 2020	Italian students	March –April 2020 (precise period unknown but during the peak of COVID-19 in Italy)	Cross-sectional, $N = 934$ (mean age 23.6 years (± 4.9), 79,6% female)	Risk and protective factors associated with PTSD during the peak of COVID-19 in Italy	Being a university student	Students' COVID-19 related concerns increased by 30% the likelihood of having PTSD. However, when the interaction of health engagement with risk and protective factors was taken into account, the association between concerns and PTSD decreased by roughly 20%.
Copeland et al., 2021	US college students)	Two waves; T0 (beginning of the Spring semester 2020), T1 (end of the Spring semester 2020) and daily surveys across the school year	Longitudinal, $N = 675$ (91.4% aged 18 years, 7.6% aged 19 years, 0.6% aged 20 years, 0.3% aged 21 years, 74,1% female)	The impact of the pandemic on the mental health of college students	Being a full-time, first-year UVM undergraduate student, being aged 18 to 25 years old, having an iPhone 5 or newer (for app compatibility)	Students reported how disruptive COVID had been to them personally. The mean level of disruptiveness (total score ranging from 0 to 10) was 7.8 (SD=2.1),with 87.3% reporting a score of 6 or greater. After the onset of the COVID-19 pandemic, externalizing problems and attention problems increased after the onset of COVID, while internalizing symptoms did not increase.
Waselewski et al., 2020	US youth	March 20 2020,	Cross-sectional, $N = 950$ (mean age 18.9 years (±2.8), 52.1% female), 67.7% White, 14.5% Black, 5.4% Asian, 12.4% other race)	The needs, emotions, and coping behaviours of US youth during COVID-19	Being part of the MyVoice cohort	32.6% of the respondents felt resources they needed, or could need, were readily available, while 35.2% of participants felt resources were difficult to access or unavailable. Respondents described both emotional responses (27.4%) and coping strategies (69.8%) to handle the impact of COVID-19.
Shanahan et al., 2020	Swiss young adults	Two waves; T0 (before COVID when participants were 20 years old, precise period unknown) and T1 (April 11 - 18 2020, during week 4 of the Swiss national lockdown)	Longitudinal, $N = 768$ (48.1% female)	The influence of previous distress and stressors in emotional distress (PSS) during the COVID-19 pandemic and to investigate how COVID-19-related stressors and coping strategies are associated with emotional distress when pre-pandemic distress was accounted for	Being a participant of the 'age 20 assessment' (wave 8) of the Zurich Project on the Social Development from Childhood to Adulthood (z-proso)	Perceived stress ($M = 2.91$, SD=0.92) and anger ($M = 2.59$, SD=0.95) during the pandemic was higher compared to perceived stress ($M = 2.79$, SD=0.95) and anger ($M = 2.37$, SD=0.75) in the pre-pandemic period (wave 8 z-proso), although no increase in internalizing symptoms was observed. The largest risk factor for emotional distress during COVID-19 was previous emotional distress.

ported. During the COVID-19 pandemic in Germany, older individuals showed higher life satisfaction and quality of life and lower levels of trait anxiety compared to younger age groups (March – April 2020, $N = 494$) (Bidzan-Bluma et al., 2020). A cross-sectional study in the US (March – April 2020, $N = 833$) showed that subjects of 60–70 years of age reported higher stress levels compared to older people (>71 years) (Emerson, 2020). Another US survey study with elderly (March 2020, $N = 825$) revealed that less than 15% of the participants reported pandemic-related stress from confinement/restrictions, isolation, loneliness and concern for others and the unknown future. In particular, stress from concern for others and the unknown future was associated with poorer psychological well-being (Whitehead and Torossian, 2021). In Spain (March - April 2020, $N = 1639$) (Garcia-Fernandez et al., 2020) and the UK (April - May 2020, $N = 15{,}530$) (Li and Wang, 2020), elderly people reported less psychopathology compared to younger people. Also, when compared to younger age groups, lower COVID-19 Peritraumatic Distress Index (CPDI) scores (Brazil, March 2020, $N = 638$) (Zhang et al., 2021), lower rates of suicidal ideation (Greece, April - May 2020, $N = 5116$) (Papadopoulou et al., 2021), and lower rates of depression, anxiety and stress (Northern Spain, March - April 2020, $N = 1933$), were reported in the elderly (Ozamiz-Etxebarria et al., 2020). These findings might indicate that at least a sub-population of the elderly is remarkable resilient, potentially due to their complex experiences during their previous lives. The discrepancy of the findings in elderly people might heavily depend on the geographical location, timing of the measurements, and the nature of the assessed sample.

5.1. Elderly with cognitive symptoms and dementia

Elderly with cognitive symptoms may be more prone to the mental effects of the pandemic. In Italy (April – May 2020, $N = 126$), daily physical activity and adherence to a healthy diet were found to be decreased in this population. However, less than 20% of the participants reported depression and anxiety, which was related to living alone, having less social interaction and reduction in leisure activities (Di Santo et al., 2020). Based on a review on patients with a dementia diagnosis (summarizing 20 studies from March 2020 and June 2020), anxiety, apathy, and agitation were the most reported neuropsychiatric symptoms during the COVID-19 pandemic, probably due to decreased social interaction (Simonetti et al., 2020).

Conclusion: Recent evidence points out that even though elderly people are more vulnerable to the physical effects of COVID-19, they also report lower psychopathology during the pandemic period compared to younger age groups. In the elderly population, patients with cognitive decline may be more vulnerable to the mental health effects of the pandemic. However, there is quite some heterogeneity within groups, and a significant proportion of the elderly people may still be at risk for worse mental health outcomes. Table 4 presents findings from cross-sectional and longitudinal studies on the impact of COVID-19 on stress resilience and mental health in elderly people.

6. Pregnant women

During the first days of the pandemic, it was not clear whether a COVID-19 infection would affect pregnant women and whether the virus would be transmitted to the fetus. Many pregnant women therefore avoided visiting hospitals, and obstetricians in India reported that a great majority of their pregnant patients experienced anxiety about their hospital visits during the first wave of the COVID-19 pandemic (April - May 5, 2020, $N = 118$) (Nanjundaswamy et al., 2020). These worries in pregnant women were related to COVID-19-related concerns about being present in public places, perceived infection risk, visiting hospitals, health of the fetus, delivery concerns, a family member being infected, or transmission of COVID-19 to the baby during delivery (Akgor et al., 2021; Taubman-Ben-Ari et al., 2020; Zhang et al., 2020). A nationwide cross-sectional study from Mexico (May – June 2020, $N = 503$) found that 33.2% of pregnant women reported being stressed based on the Perceived Stress Scale, with perceived stress being significantly correlated with later gestational age (Medina-Jimenez et al., 2020). In China (February – March 2020, $N = 560$), over half of pregnant women reported feeling horrified, apprehensive, or helpless during the pandemic (Zhang and Ma, 2020). A Turkish study reported that half of the 172 enrolled pregnant women in the third trimester reported feeling vulnerable to the effects of the pandemic (April 2020) (Yassa et al., 2020a). In a Pakistani (August 2020, $N = 552$) and Chinese study (February 2020, $N = 1947$), more than 80% of the pregnant women reported that they themselves and their fetuses were more vulnerable to the effects of the pandemic compared to the general population (Liu et al., 2020b; Shahid et al., 2020), but moderate to severe anxiety was reported in only 3% (Liu et al., 2020b). A systematic review, that included 15 studies examining depression and anxiety symptoms in pregnant or delivered women during the COVID-19 pandemic, reported a pooled overall prevalence of 30% for depression and of 34% for anxiety (Sun et al., 2020). In addition, the prevalence of depression and anxiety symptoms was around two times higher compared to non-pregnant women (Sun et al., 2020). Another systematic review and meta-analysis that included 19 studies about the mental health status of pregnant women during the COVID-19 pandemic reported a prevalence between 5 and 38% for depression and anxiety symptoms (overall prevalence of 25%) and a pooled overall prevalence of anxiety of 42% (Fan et al., 2020). A rare longitudinal study in Argentina confirmed significant increases in depressive, anxiety and negative affect in 102 pregnant women at 2, 14, and 47 days after the start of the lockdown compared to 102 non-pregnant women (Lopez-Morales et al., 2021). During the pandemic, 1754 pregnant women in Canada reported significantly higher levels of depressive, anxiety, dissociative and post-traumatic stress symptoms compared to a pre-COVID-19 cohort of pregnant women (Berthelot et al., 2020). However, again, conflicting results are reported. A Turkish study (April 2020) found lower state anxiety in 203 pregnant women compared to 101 non-pregnant women

Table 4 The impact of COVID-19 on stress resilience and mental health in elderly people.

Study	Population	Time period/ Wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/ summary
Spalletta et al., 2020	Italian patients with mild and major neurocognitive disorders (NCD)	January - April 2020 (precise period unknown)	Cross-sectional, $N = 251$ canceled scheduled appointments	Number of canceled appointments for patients with NCD due to COVID-19 compared to these numbers in January – April 2019	Having recorded the number of appointments that were canceled at the Santa Lucia Foundation IRCCS due to the government-enforced reduction of non-urgent healthcare services in Italy during the lockdown	251 scheduled appointments were canceled (follow-up appointments $N = 211$; first-time appointments $N = 40$). There was a significant difference in the proportion of canceled follow-up and first-time appointments in March and April 2020 compared to the same periods in 2019.
Rodriguez-Gonzalez et al., 2020	Spanish adults	March 2020, during the lockdown of the COVID-19 first wave (precise period unknown)	Cross-sectional, $N = 528$ (mean age 69.25 years ($\pm$6.75), 64.6% female)	Psychological and social implications and health-related behaviours involved in the lockdown due to the COVID-19 pandemic	Being 60 years or older, living in Galicia (North-West region of Spain, Europe) during the lockdown declared in March 2020 by the Spanish government due to the COVID-19 pandemic	76.5% of sample belonged to active aging organizations before lockdown, but only 33.7% continued to be active during lockdown; 65.7% performed less physical activity than before the lockdown; 25.6% of the sample reported an increase in intellectual activity; 66.3% feel that their physical health will not worsen; 67.6% believe that this situation will not have a positive effect.
Parlapani et al., 2020	Greek adults	The survey was online for a period of three days, three weeks after a national lockdown had been imposed in Greece (March 23 2020,)	Cross-sectional, $N = 103$ (mean age 69.85 years ($\pm$5.26), 61.2% female)	Psychological response of older adults during the acute phase of the pandemic in Greece	Being older than 60 years, having online access to the survey via social media	81.6% reported moderate to severe depressive symptoms; 84.5% reported moderate to severe anxiety symptoms; 37.9% reported disrupted sleep. Females disproportionately reported significantly higher levels of COVID-19-related fear, depression, sleep disturbances, and an intolerance of uncertainty.

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Table 4 (*continued*)

Study	Population	Time period/ Wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/ summary
Cohen, G. et al., 2020	Argentinian family members of patients of the Aging and Memory Center of FLENI with Alzheimerś dementia (AD) and related disorders	After the first 8 weeks of quarantine (starting medio March 2020, precise period unknown)	Cross-sectional, $N = 119$ caregivers of persons with AD or related dementia living at home (mean age of patients 81.16 years ($\pm$7.03), 64.7% female)	To study the extent mandatory quarantine due to COVID-19 affected behavioural symptoms in subjects with dementia after the first 8 weeks of quarantine	Being a family member of patients of the Aging and Memory Center of FLENI in Argentina, with AD and related disorders	Family members reported 60.5% new onset or exacerbation of pre-existing behavioural symptoms; 33% anxiety, 12.8% depression, and 14.7% sleep disorders were reported; 40% reported increasing gait difficulties; 20% increased use of antipsychotics, 15% benzodiazepines, 6% hypnotics, and 10% antidepressants. 76% discontinued physical therapy, 91% occupational therapy, and 77% cognitive rehabilitation.
Schweda et al., 2021	German general population	March 1 - May 4 2020, (period in which people lived under the curtailment of their individual freedoms and partly unprecedented governmental restrictions)	Cross-sectional, $N = 15,308$ (13.9% aged 18-24 years, 24.8% aged 25-34 years, 23.0% aged 35-44 years, 19.0% aged 45-54 years, 14.2% aged 55-64 years, 4.4% aged 65-74 years, 0.8% aged >75 years, 70.7% female)	Psychological reactions in response to real or perceived COVID-19 infection threats	Being involved in social media groups, living under the curtailment of individual freedom between March 10 - May 4 2020,	COVID-19 related fear correlated with generalized anxiety ($\rho = 0.377$, $p < 0.001$, 95%-CI = [0.363: 0.391]). COVID-19 related fear increased with age; generalized anxiety decreased with age.
Bidzan-Bluma et al., 2020	German and Polish adults	March 27 - end of April 2020 (during the period of COVID-19 restrictions)	Cross-sectional, $N = 494$ (mean age 42.97 years ($\pm$9.77), 72% female, 80.6% German, 19.4% Polish)	Predictors of quality of life, well-being, sleep, and life satisfaction, including factors such as risk behavior, trait anxiety, feeling of threat, sleep quality, and optimism, during the pandemic in older people from Germany and Poland	Being 18 years or older, having access to the internet in order to fill out the study survey	Older people rated quality of life, life satisfaction, and well-being higher than young people and scored less than young people on anxiety (mean difference= -9.19, SE = 1.90, $p < 0.01$) and greater than young people on risk tolerance (mean difference = 1.38, SE = 0.33, $p < 0.01$ difference=0.91, SE = 0.31, $p < 0.05$).

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Table 4 (*continued*)

Study	Population	Time period/ Wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/ summary
Emerson, 2020	US adults aged 60 years and older	March 30 - April 12 2020,	Cross-sectional, $N = 833$ (age range 60–80 years, 62.8% aged 60–70 years, 80.5% female, 96.0% White, 1.9% Black or African American, 0.2% American Indian or Alaska Native, 1.6% Asian, 2.1% other)	The impact of sheltering in place and social distancing among adults aged 60 and older	Being 60 years or older, living in the US and practicing social distancing between March 30 and April 12, 2020	36% reported being stressed and 42.5% reported being lonely. Loneliness increased with time of social distancing.
Whitehead & Torossian, 2021	US adults aged 60 and older	March 22–23 2020 (period in which stay-at-home orders were beginning to be issued)	Cross-sectional, $N = 825$ (63.8% aged 60–69 years, 30.7% aged 70–79 years, 5.5% aged $\geq$80 year, 79,3% female)	Older adults' reports of what was stressful about the pandemic, and what was joyful and comforting amidst the stress	Being 60 years or older, having access to the online survey	13.2% reported restrictions and resulting confinement as a source of stress and 31.6% mentioned family or friends as the most frequently reported source of joy or comfort. Stress over concern for others, the unknown future, and contracting the virus was significantly associated with poorer psychological well-being; whereas faith, exercise/self-care, and nature were associated with more positive psychological well-being.
Garcia-Fernandez et al., 2020	Spanish adults	March 29 - April 5 2020„ covering the peak of the COVID-19 infection in Spain	Cross-sectional, $N = 1639$ ($N = 150 \geq 60$ years old, 58.7% female, $N = 1489$ <60 years old, 69.2% female)	COVID-19 outbreak-related emotional symptoms, gender differences, and the relationship between the emotional state and environmental features in the elderly	Not being a healthcare worker, not having a current or past mental illness	The $\geq$60 age group showed lower depression scores and lower acute distress scores than the <60 age group. There were no gender differences in any of the clinical measures.

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Table 4 (*continued*)

Study	Population	Time period/ Wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/ summary
Li & Wang, 2020	UK adults aged from 18 to over 65 years old	April 24 – 30 2020	Cross-sectional, $N = 15,530$	The prevalence and predictors of general psychiatric disorders and loneliness after the first diagnosis of COVID-19	Having participated in the first wave of Understanding Society COVID-19 Study	This study showed high prevalence rates of general psychiatric disorders (29.2%) and loneliness (35.86%) during the COVID-19 pandemic. People with current or past COVID-19-related symptoms or various disadvantaged socioeconomic backgrounds were at significantly higher risks of general psychiatric disorders and loneliness.
Zhang, et al., 2021	Brazilian adults	March 25 –28 2020 (one month after the first COVID-19 case in Brazil	Cross-sectional, $N = 638$ (18.5% aged 18–25 years, 32.3% aged 26–35 years, 24.4% aged 36–45 years, 13.5% aged 46–55 years, 8.8% aged 56–65 years, 2.5% aged >65 years, 57.7% female)	Mental distress and its associated predictors among adults one month into the COVID-19 crisis in Brazil	Unknown	52% of the sampled adults experienced mild or moderate distress, and 18.8% suffered severe distress. Adults who were female, younger, more educated, and exercised less reported higher levels of distress.
Papadopoulou et al., 2021	Greek adults	April 7 - May 3 2020,	Cross-sectional, $N = 5116$ (28.15% aged 35–44 years, 23.60% aged 45–54 years, 73.64% female)	Prevalence of suicidal ideation in the community as well as the risk and protective factors of suicidal ideation during restriction measures in Greece	Unknown	5.20% reported suicidal thoughts, 14.17% were potential clinical cases of anxiety, and 26.51% of depression. Participants presented significantly higher suicidal ideation rates during the last two weeks of the lockdown compared to its previous two weeks.
Ozamiz-Etxebarria, et al., 2020	Spanish adults	March 11- 18 2020 (55.8% of participants) and April 2–12 2020. (44.2% of participants)	Cross-sectional, $N = 1933$ (mean age 33.80 years ($\pm$ 16.65), 79.5% female)	Psychological state of the general population during the COBID-19 lockdown	Unknown	More than a quarter of the participants reported symptoms of depression (27.5%), anxiety (26.9%) and stress (26.5%) and as the time spent in lockdown has progressed, psychological symptoms have risen.

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Table 4 (*continued*)

Study	Population	Time period/ Wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/ summary
Elderly with cognitive symptoms and dementia						
Di Santo, et al., 2020	Italian adults with mild cognitive impairment (MCI) or subjective cognitive decline (SCD)	April 21 - May 7 2020,	Cross-sectional, $N = 126$ ($N = 70$ MCI and $N = 56$ SCD patients, mean age 74.29 years (6.51±), 81.0% female)	The effects of COVID-19 and quarantine measures on lifestyles and mental health of elderly at increased risk of dementia	Being 60 years or older, having undergone the last study visit in the preceding 18 months, not having a significant functional impairment in the last study visit, having a diagnosis of MCI according to the International Working Group criteria, and having a cognitive impairment, operationalized as a MMSE score ≥ 20 and ≤ 26 (or ≤ 28 for participants with 16 or more years of education) or as a score under the normative cut-off in at least one domain-specific cognitive test from an extensive neuropsychological battery	Over 1/3 of the sample reduced their physical activity and nearly 70% reported an increase in idle time. Adherence to the Mediterranean diet decreased in almost 1/3 of respondents and over 35% reported weight gain. Social activities were abolished and 1/6 of participants also decreased productive and mental-stimulating activities. 19.8% were depressed, 9.5% anxious, and 9.5% apathetic.

(Yassa et al., 2020b). In China (February - March 2020, $N = 859$;), pregnancy was associated with a lower risk for depression, anxiety, insomnia, and PTSD (Zhou et al., 2020b). Another Israelian study (March – May 2020, $N = 369$) also reported lower rates of depression in pregnant women hospitalized during the pandemic, compared to pregnant women that were hospitalized before the pandemic (Sade et al., 2020). Pre-existing psychiatric disorders appear to increase the experience of depressive, anxiety and dissociative symptoms in pregnant women during the pandemic (Berthelot et al., 2020; Liu et al., 2021; Ravaldi et al., 2020), and previous anxiety disorders increases health-related and society-related anxiety levels (Berthelot et al., 2020; Ravaldi et al., 2020).

There are several factors that may impact on the level of stress resilience specifically in pregnant women. Maternal social support in China and Ethiopia significantly decreased anxiety levels in pregnant women (Yue et al., 2020), and also increased health-related quality of life (Dule et al., 2021). Social support in Canada was also negatively correlated with depression and insomnia, whereas negative cognitive appraisal positively correlated with these symptoms (Khoury et al., 2021). Risk of COVID-19 infection (Bo et al., 2020), social isolation (Durankus and Aksu, 2020), financial and relationship difficulties (Bo et al., 2020; Khoury et al., 2021; Lebel et al., 2020; Matsushima and Horiguchi, 2020; Mortazavi et al., 2021), marital life satisfaction (Effati-Daryani et al., 2020), intimate partner violence (Almeida et al., 2020), sleep difficulties (Lin et al., 2021), were reported factors that relate to psychopathology in pregnant women during the COVID-19 pandemic. In addition, having a relative with COVID-19 infection, a history of abortion, and an age below 30 increased pregnant women's worries (Mortazavi et al., 2021). In the US (April – May 2020, $N = 787$), compared to white women, black women reported significantly higher rates of depression, more pregnancy-related worries, more worries about the financial burden of the pandemic and having a job that is negatively affected by the pandemic (Gur et al., 2020). Finally, a report from Iran (March – April 2020, $N = 580$) showed that fear of COVID-19 was associated with suicidal ideation, quality of life and depression in 290 pregnant women (Ahorsu et al., 2020).

Conclusion: Although several cross-sectional studies, mostly surveys, report that pregnant women experienced higher levels of stress, depression and anxiety during the pandemic period compared to non-pregnant women, several other studies found comparable or even better mental health outcomes. It remains quite challenging to assess the prevalence of anxiety and depression in pregnant women during the COVID-19 pandemic compared to the pre-pandemic period. Regarding risk factors, lack of social support and fear about pandemic-related issues reduced the stress resilience of pregnant women. An important aspect for future studies will be to assess the impact of the pandemic-related stress exposure during pregnancy on the children of these mothers. For an overview of findings from cross-sectional and longitudinal studies on the impact of COVID-19 on stress resilience and mental health in pregnant women, see Table 5.

7. Patients with a psychiatric disorder

7.1. Adults with a psychiatric disorder

Whilst facing the COVID-19 pandemic has important negative consequences in terms of mental health and increases the vulnerability for psychological problems, severe mental illness in turn has been shown to represent a vulnerability factor for COVID-19 infection. Several studies have shown that patients affected by severe mental illness have an increased risk to become infected compared to the general population (odds ratios ranging from 5.7 to 7.6) (Lee et al., 2020; Li et al., 2020; Wang et al., 2020b), which is linked to poorer environmental conditions, such as socioeconomic deprivation. Furthermore, they might have more difficulties with being compliant to the rules and obligations established to fight the pandemic and tend to be generally exempt by wearing personal protective equipment such as masks (Ayuso-Mateos et al., 2020). Indeed, in their analysis of anonymized electronic health records of 62,354 US patients affected by COVID-19 (January – August 2020), Taquet et al. clearly showed that the presence of a pre-existing psychiatric illness was significantly associated with a higher risk of a COVID-19 diagnosis (RR=1.65, 95% CI: 1.59-1.71, $p < 0.0001$), independent of known physical health or economic and housing risk factors (Taquet et al., 2021). This finding was confirmed by a recent analysis of de-identified population-level electronic health records data ($N = 61,783,950$) from US hospitals, which showed that individuals with a recent diagnosis of a mental disorder had a significantly increased risk for COVID-19 infection, with an effect strongest for depression (OR=7.6) and schizophrenia (OR=7.34) (Wang et al., 2020b). Of interest, this increased risk was further exacerbated among African Americans and women. It is plausible that these patterns of associations might be also related to the effect that COVID-19 has exerted on the levels of clinical care in psychiatry which showed a substantial decrease since the start of the pandemic (Carpiniello et al., 2020; Yao et al., 2020).

In this context, stress resilience appears among one of the many plausible moderators of the identified increased risk of infection in patients affected by severe mental illness (Ameis et al., 2020; Jacob et al., 2020). This is of relevance given that building resilience in the general population and at-risk patient populations will be a key instrument to decrease the impact of the COVID-19 related socioeconomic shock (Jacob et al., 2020). Indeed, there is evidence that specific factors such as having a higher academic level, being autonomous, having self-efficacy, and the presence of optimism have been shown to be significant predictors of resilience in the general population during the COVID-19 pandemic (Robles-Bello et al., 2020), protecting individuals from the development of mental disorders. This points to the importance of building resilience in at risk population such as those affected by severe mental disorders. Indeed, the work from Burrai et al. has shown that Italian psychiatric patients in residential community (April – May 2020, $N = 82$) scored lower than healthy individuals in levels of stress although, as expected, they showed higher levels of anxiety, perceived risk of getting infected with COVID-19 and worry about the emergency situation (Burrai et al., 2020). This finding is probably justified by the perceived and experi-

Table 5 The impact of COVID-19 on stress resilience and mental health in pregnant women.

Study	Population	Time period / wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
Nanjundaswamy et al., 2020	Indian obstetricians	April 5 - May 5 2020,	Cross-sectional, $N = 118$ (89.83% female)	COVID-19 related concerns expressed to obstetricians by pregnant and postpartum women	Unknown	40,86% of the participants reported anxieties related to social media. The most common anxieties and distress reported were related to worrying social media messages, fear about contracting the infection, social isolation, family members not following infection control and missing out on childbirth-related rituals.
Taubman-Ben-Ari et al., 2020	Israeli Jewish and Arab pregnant women	March 18–28 2020	Cross-sectional, $N = 336$ ($n = 225$ Jewish women, mean age 31.00 years ($\pm$5.18) and $n = 111$ Arab women, mean age 28.43 years ($\pm$3.89)	COVID-19 related distress and anxiety	Being pregnant and being able to complete questionnaires in Hebrew	Participating pregnant women reported high COVID-19- related anxiety, with leaving the home (taking public transportation or being in public places) being the greatest cause for concern. Specifically, the use of public transportation (87.5%) was reported as the cause of the highest anxiety, followed by the potential infection of other family members (71.7%), being in public places (70%), concern for the fetus (70%), going for pregnancy check-ups (68.7%), being infected themselves (59.2%), and the delivery (55.4%). Arab women were more distressed and anxious compared to Jewish women.
Zhang et al., 2020	Chinese pregnant women	February 13–16 2020	Cross-sectional, $N = 1901$ (mean age 28.9 years ($\pm$4.7)	Presence of prenatal depression (PND) and post-traumatic stress disorder (PTSD) during the COVID-19 pandemic	Being in the second or third trimester of pregnancy	During the early stage of the COVID-19 outbreak, high anxiety levels, a high prevalence of probable PND (34%) and a high prevalence of suspected PTSD (40%) was observed among pregnant women.

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Study	Population	Time period / wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
Akgor et al., 2021	Pregnant women without psychiatric history attending an university clinic in Ankara, Turkey	May 2020 (precise period unknown)	Cross-sectional, $N = 297$ (mean age 27.64 years ($\pm$5.27))	The psychological impact and perceptions during the COVID-19 pandemic in pregnant women	Not having a psychiatric history	The majority of pregnant women in this study reported COVID-19 related concerns about their pregnancy and delivery (i.e. concerns about infecting their baby during delivery, not being able to reach their doctors and pregnancy complications because of canceled/postponed check-ups).
Medina-Jimenez et al., 2020	Mexican pregnant women	May 5 - June 12 2020,	Cross-sectional, $N = 503$ (mean age 28.1 years ($\pm$6.25))	The impact of the COVID−19 pandemic on the levels of stress (Perceived Stress Scale; PSS) and depression (Edinburgh's Postnatal Depression Scale; EPDS) of pregnant women in Mexico	Attending prenatal care from public and private hospitals	33.2% of the participants was highly stressed (having a score of 27 or higher on the PSS) and a significant increase in PSS scores was observed in the third trimester of pregnancy. 17.5% of the participating pregnant women were considered as being depressed (having a score of 14 or higher on de EPDS).
Zhang, & Ma, 2020	Chinese pregnant women residing in Liaoning Province	February - March 2020 (precise period unknown)	Cross-sectional, $N = 560$ (mean age 25.8 years ($\pm$2.7))	The attitude towards COVID-19, psychological and stress impact among pregnant women amid the COVID-19 pandemic's immediate wake	Having a Chinese nationality, being 18 years or older	During the early stages of the COVID-19 pandemic, Chinese pregnant women reported moderate-to-severe stressful and psychological impact of the pandemic.
Yassa, M. et al., 2020	Turkish pregnant woman at a single tertiary "Coronavirus Pandemic Hospital" referral center	April 2020 (precise period unknown)	Cross-sectional, $N = 172$ (mean age 27.5 years ($\pm$5.3))	The attitude, concerns, and knowledge of non-infected pregnant women towards the COVID-19 outbreak	Not being infected with COVID-19, not having a psychiatric history, having a confirmed pregnancy over the 30th gestational week	Women had a positive attitude and compliance towards the COVID-19 outbreak and the healthcare staff. However, the majority of the women also felt vulnerable and approximately one third of the pregnant women reported concerns about getting infected during or following the delivery or their new-born baby getting infected.

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Study	Population	Time period / wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
Shahid et al., 2020	Pakistani pregnant women at an out-patient clinic in Pakistan	August 6 −20, 2020	Cross-sectional, $N = 552$ (mean age 32.0 years (±7.3))	Levels of depression, anxiety and impact of the COVID-19 outbreak	Not having a psychiatric history or other comorbidities	61% of pregnant women neither felt depressed nor anxious and were likely to be well. 39% of pregnant women stated that the COVID-19 pandemic had caused them depression and anxiety, while 33% were found to have possible depression, with EPDS scores of 10 or greater. Pregnancy was a determinant factor for negative perceptions of the COVID-19 pandemic (e.g. being exposed, more vulnerable, and fearing vertical transmission or harm to the pregnant woman).
Liu, X. et al., 2020	Chinese pregnant women registered for prenatal care in Wuhan and Chongqing	February 3-9 2020	Cross-sectional, $N = 1947$ ($n = 932$ women form Wuhan, 90.45% aged <35 years, $n = 1015$ women from Chongqing, 87.78% aged <35 years)	The mental status (Self-Rating Anxiety Scale; SAS) of pregnant women and their obstetric decisions during the COVID-19 outbreak	Being registered for prenatal care in hospitals in Wuhan and Chiongqing	More women in Wuhan felt anxious (24.5% versus 10.4% of non-Wuhan women). Factors that influenced anxiety included household income, subjective symptom and attitudes. Overall, obstetric decisions also revealed city-based difference.
Lopez-Morales et al., 2021	Argentinian women	Three waves; T0 (March 22 - 25 2020), T1 (April 3-9 2020), T2 (May 6-10 2020) 2, 14, and 47 days after the start of the lockdown respectively	Prospective longitudinal case-control (3 waves), $N = 204$ (mean age 32.56 years (±4.71))	Psychopathological consequences of the COVID-19 pandemic in pregnant women, compared to non-pregnant women	Being older than 18 years, living in Argentina, not having serious physical/psychological diseases and absence of risk factors for COVID-19, for pregnant mothers: only having a single pregnancy (in any week of gestation)	In a time range of 50 days of quarantine, pregnant women showed a higher increase in depression, anxiety and negative affect and a higher decrease in positive affect compared to non-pregnant women.

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Study	Population	Time period / wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
Berthelot et al., 2020	Two cohorts of Canadian women (one pre and one post-COVID-19)	April 2–13 2020 (COVID-19 cohort)	Cross-sectional, $N = 1754$ (mean age 29.27 years ($\pm$4.23))	The extent to which the COVID-19 pandemic may aggravate the prenatal distress and psychiatric symptomatology of pregnant women	Being 18 years or older, having sufficient reading skills to complete self-report instruments	Pregnant women during the COVID-19 pandemic reported higher levels of depressive, anxiety, dissociative and PTSD symptoms, negative affectivity and less positive affectivity compared to a pre-COVID-19 cohort of pregnant women.
Yassa, M. et al., 2020	Turkish pregnant and non-pregnant woman at a single tertiary "Coronavirus Pandemic Hospital" referral center	April 2020 (precise period unknown)	Cross-sectional, $N = 404$ (mean age 27.4 years ($\pm$5.3))	State/trait anxiety and obsessive-compulsive symptoms during the COVID-19 pandemic of pregnant women compared to non-pregnant women	Not having a COVID-19 and psychiatric history	Pregnant women showed increased OCD symptoms and less severe anxiety levels compared with non-pregnant women.
Zhou, Y. et al., 2020	Chinese pregnant and non-pregnant women in several Maternal and Child Health Hospitals in Beijing during the epidemic of COVID-19	February 28 - March 12 2020,	Cross-sectional, $N = 859$ ($n = 544$ pregnant women, mean age 31.1 years ($\pm$3.9) and $n = 315$ non-pregnant women, mean age 35.4 years ($\pm$5.7))	The prevalence of depression, anxiety, physical discomfort, insomnia and post-traumatic stress disorder (PTSD) during the COVID-19 pandemic	Having a childbearing age	During the COVID/19 pandemic, pregnant women had lower scores of symptoms of depression, anxiety, and PTSD (all $p < 0.05$) compared to non-pregnant women.

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Study	Population	Time period / wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
Sade et al., 2020	Israeli women hospitalized in the high-risk pregnancy units of a University Medical Center in Israel	March 19 - May 26 2020,	Cross-sectional, $N = 369$ ($n = 84$ women hospitalized during COVID-19 (2.4% aged <20 years, 79.8% aged 20–35 years, 17.9% aged >35 years), and $n = 270$ women hospitalized before COVID-19 (4.3% aged <20 years, 82.4% aged 20–35 years, 13.3% aged >35 years))	The incidence of depression among women hospitalized in the high-risk units during the COVID-19 strict isolation period	Having a high-risk pregnancy	Results showed that women hospitalized in the high-risk pregnancy units during the COVID-19 pandemic had comparable risk for depression compared to the comparison group of high-risk pregnant women not hospitalized during the pandemic.
Ravaldi, et al., 2020	Italian pregnant women	March 18–31 2020	Cross-sectional, $N = 737$ (median age 34.4 years (range 18.4–47.4))	The association of concern, anxiety and PTSD symptoms with age, gestational weeks, parity, days of COVID-19 lockdown, assisted reproductive technology use, psychopathological history, and previous perinatal losses during the first period of lock-down	Being currently pregnant and being older than 18 years	Pregnant women were very concerned about COVID-19 and showed a high prevalence of anxiety and posttraumatic stress disorder symptom. Women with self-reported history of anxiety and/or depression were significantly more concerned about COVID-19 and were at a higher risk of developing symptoms of anxiety and posttraumatic stress disorder.
Liu, C. H. et al., 2021	US perinatal women	May 21 - August 17 2020,	Cross-sectional, $N = 1123$ (mean age 33.10 years ($\pm$ 3.77))	COVID-19-related health, worries and grief, and depression, generalized anxiety and PTSD symptoms	Being older than 18 years, starting from the second trimester of pregnancy or having given birth in the past six months	Pre-existing mental health diagnoses as well as COVID-19-related health worries and grief experiences may increase the likelihood of mental health symptoms in perinatal women.
Yue, C. et al., C. 2020	Chinese pregnant women	February 16–21 2020	Cross-sectional, $N = 308$ (mean age 31.02 years ($\pm$3.9))	The relationship between social support, risk perception and anxiety among third-trimester pregnant women during the COVID-19 pandemic	Having a current pregnancy (third trimester)	The third trimester pregnant women had a high level of social support, a medium level of risk perception to COVID-19 and were susceptible to anxiety. Risk perception played a mediating role between social support and anxiety.

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Table 5 (*continued*)

Study	Population	Time period / wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
Dule, A. et al., A. 2021	Ethiopian pregnant mothers	August 1 −15, 2020	Cross-sectional, $N = 384$ (mean age 31.3 years (± 7.7))	The quality of life among pregnant mothers during COVID-19 and its association with social support and fear of the pandemic	Not having a high-risk pregnancy	Perceived social support was positively linked to quality of life and COVID-19-related fear impaired quality of life.
Khoury, et al., 2021	Canadian pregnant women	June 3 - July 31 2020,	Cross-sectional, $N = 303$ (mean age 32.13 years (±4.22))	The prevalence of mental health difficulties in pregnant individuals during the COVID-19 pandemic	Living in Ontario, Canada, being able to read and write in English, being 18 years or older, ≤ 36 weeks gestation	During the COVID-19 pandemic, pregnant women experienced significantly elevated symptoms of depression and anxiety and comparable rates of insomnia compared to a pre-COVID-19 sample of pregnant women.
Bo et al., 2020	Chinese women	February 22 - March 10 2020,	Cross-sectional, $N = 1309$ (mean age 29.99 years (±4.53))	The prevalence of depression (9-item Patient Health Questionnaire - PHQ-9) during the COVID-19 pandemic and its associated factors in women in the perinatal stages	Being a woman in the third semester of pregnancy, or post-partum period (from the beginning of pregnancy to one week after childbirth), being 18 years or older, not having a pre-existing psychiatric disorder	A high prevalence of depression in women across the perinatal stages was observed. Worries about infection and interrupted routine medical check-ups were associated with an increased risk of depression.
Durankus & Aksu, 2020	Turkish pregnant women	Not reported	Cross-sectional, $N = 260$ (mean age 29.56 years (±3.83)))	The effects of the COVID-19 pandemic on depression and anxiety in pregnant women, using the Edinburgh Postnatal Depression Scale (EPDS)	Not having a history of a psychiatric disorder	35.4% of the participating pregnant women scored higher than 13 on the EPDS and were thus being considered as being at risk of developing depression. COVID-19 pandemic effects regarding psychology and social isolation, anxiety symptoms and depressive symptoms contributed to increased depression in pregnant women.

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Table 5 (*continued*)

Study	Population	Time period / wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
Lebel et al., 2020	Canadian pregnant women	April 5–20 2020	Cross-sectional, $N = 1987$ (mean age 32.4 years ($\pm$4.2))	The prevalence of anxiety and depression symptoms in pregnant women during the COVID-19 pandemic and potential resilience factors associated with lower symptoms	Having a confirmed pregnancy (<35 weeks gestation)	Elevated symptoms of anxiety and depression were found among pregnant individuals during the COVID-19 pandemic; potential protective factors included increased social support and physical exercise.
Matsushima & Horiguchi, 2020	Japanese women	May 31 - June 6 2020,	Cross-sectional, $N = 1777$ (5.35% aged <25 years, 29.21% aged 25–30 years, 37.20% aged 30–34 years, 28.25% aged $\geq$35 years)	Depressive symptoms in pregnant women during the COVID-19 pandemic, using the Japanese version of the Edinburgh Postnatal Depression Scale (EPDS)	Being pregnant or recently gave birth (postpartum)	17% of pregnant women suffered from depressive symptoms. Depression scores were positively correlated with cancelation of planned informal support, higher perceived risk for infection, difficulties in household finances, lack of social support; being younger, being less wealthy, being unemployed, and not having a partner.
Mortazavi et al., 2021	Iranian pregnant women	May 5 - August 5 2020,	Cross-sectional, $N = 484$ (mean age 28.3 years ($\pm$5.8))	Well-being (WHO-5 Well-Being Index) of pregnant women and the effect of concerns and fears (Cambridge Worry Scale) on maternal well-being during the COVID-19 pandemic	Having a single healthy fetus and no significant psychological disorder	The percentage of women experiencing a low well-being state was relatively high. Predictors of experiencing low well-being were worry about own health, health of others and the fetus, having at least one infected person with COVID-19 among relatives.

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Table 5 (*continued*)

Study	Population	Time period / wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
Effati-Daryani et al., 2020	Iranian pregnant women	March - April 2020 (precise period unknown)	Cross-sectional, $N = 205$ (mean age 39.3 years (±5.5))	Depression, stress, and anxiety levels, and their predictive factors in pregnant women during the COVID-19 pandemic	Having a file in the health centers of Tabriz, having a mobile phone and a healthy pregnancy, not having a history of mental illness, medical problems during pregnancy, and high-risk pregnancies	Higher depression, stress and anxiety levels were correlated with education level, spouse's support and job, marital life satisfaction, number of pregnancies, household income sufficiency.
Lin et al., 2021	Chinese pregnant women	February 17 - March 16 2020,	Cross-sectional, $N = 751$ (mean age 30.51 years (±4.28))	Mental manifestations of the COVID-19 pandemic and the impact of sleep conditions on mental health status	Not having a severe physical or mental disorder	A notable proportion of pregnant women exhibited mild anxiety and depression symptoms during the epidemic of COVID-19 mediated by sleep conditions.
Gur et al., 2020	US pregnant women	April 17 - May 1 2020,	Cross-sectional, $N = 787$ (mean age 32.45 years (±4.83), 27.4% Black, 72.6% White-Non Latina/Hispanic)	Race-related differences in COVID-19-related burden on mental health and resilience factors	Being pregnant	Significant racial disparities were observed regarding the impact of the COVID-19 pandemic and the experience of healthcare on the well-being of pregnant women. Self-reliance and emotion regulation was higher in Black women, although not related to a reduced risk for depression.
Ahorsu et al., 2020	Iranian pregnant women	March 7 - April 21 2020,	Cross-sectional, $N = 580$ ($n = 290$ pregnant women, mean age 29.54 years (± 5.84) and $n = 290$ husbands, mean age 33.62 years (±6.36))	The interdependencies between fear of COVID-19, mental health, and preventive COVID-19 behaviours	Being pregnant, being 18 years or older, being enrolled in the Integrated Health System (IHS), having a husband who agrees to participate	Significant dyadic relationships were observed between husbands and their pregnant wives' fear of COVID-19, mental health, and preventive behaviours.

enced support that residential patients receive from mental health workers and peers.

At the same time, there is evidence that COVID-19 has exerted a role as a precipitating factor for an exacerbation of existing psychiatric disorders, particularly in those disorders where stress is a key trigger, such as PTSD, mood disorders, and schizophrenia (Ettman et al., 2020; Horn et al., 2020; Jolly et al., 2020; Ma et al., 2020; Pinkham et al., 2020; Rutherford et al., 2021). For instance, in China (January – April 2020), 30 patients with schizophrenia who were socially isolated after having close contact with a COVID-19 case showed a higher severity of symptoms, including higher levels of perceived stress and anxiety and lower quality of sleep, as well as a higher inflammatory load compared to 30 patients with schizophrenia not subjected to quarantine measures (Ma et al., 2020). Of interest, there is anecdotal evidence of two cases in the US where symptoms of PTSD might have been exacerbated by public masking (Jolly et al., 2020). However, Pinkham et al. showed in 148 US individuals with severe mental illness (92 with schizophrenia spectrum illnesses and 56 with affective disorders) that affective symptoms and sleep were stable after five months from the start of the pandemic (Pinkham et al., 2020). Convincing evidence stems from three longitudinal Dutch case-control cohorts (NESDA: $N = 2329$ cases and $N = 652$ controls; NESDO: $N = 378$ cases and $N = 132$ controls; NOCDA: $N = 419$ cases), showing that patients with depressive, anxiety, or obsessive-compulsive disorders are not experiencing a large detrimental impact on their mental health during the COVID-19 pandemic compared to before, even though symptom severity remained substantially high – and many more times higher than healthy controls, indicating the burden and severity of psychiatric disorders compared to general population symptom levels (Pan et al., 2021). With regard to suicidality, a series of studies have shown that the suicide risk increased significantly during the pandemic (Iob et al., 2020b; John et al., 2020; Nomura et al., 2021; Sáiz et al., 2020; Singh, 2020; Tanaka and Okamoto, 2021). While the grim forecast from predictive models showed increased rates of suicide during the pandemic (John et al., 2020), data emerging from epidemiological observations in countries as the Netherlands and Japan found that monthly suicide rates declined during the first months of the pandemic, even though levels in Japan increased by 16% during the second wave (Tanaka and Okamoto, 2021). Other studies showed increased rates of various suicidal behavior components in the general population including passive suicidal ideation (Sáiz et al., 2020) and self-harm (Iob et al., 2020b).

7.2. Children and adolescents with a psychiatric disorder

Children and adolescents with an eating disorder diagnosis represent a vulnerable group. Reactivation of eating disorder symptoms occurred in 42% of 365 young patients followed up in an eating disorder clinic in Spain during the first 8 weeks of COVID-19, particularly in adolescents (March – May 2020, $N = 365$). In half of the cases, the clinical worsening was associated with eating restriction and excessive exercising due to reactivation of weight phobia. Social isolation and increase in family conflicts were reported as relevant factors (Graell et al., 2020). Obsessive compulsive disorder symptoms were also reported to increase in the first months of the pandemic in most children and adolescents diagnosed with OCD, in addition to increased anxiety and depressive symptoms (Denmark, April-May 2020, $N = 67$) (Nissen et al., 2020). In a Turkish study, 61 participants aged 6–18 years who had been diagnosed with OCD were assessed in April 2020. 54% reported worsening of their symptoms and 36% reported more than a 30% increase in CY-BOCS scores. On the other hand, 11.4% of the patients reported decreased symptoms. More than half of the patients who were in remission also reported increased symptoms that reached a clinically significant threshold. Among the factors that predicted worsening of OCD symptoms during the pandemic were daily preoccupation with COVID-19, searching on social media about COVID-19, duration of OCD diagnosis and a diagnosis of COVID-19 in someone familiar (Tanir et al., 2020).

Children with neurodevelopmental disorders such as attention deficit hyperactivity disorder (ADHD) and autism have shown to be at risk during the COVID-19 outbreak. A survey completed by 241 Chinese parents of children aged 6–15 years old who were diagnosed with ADHD, showed that ADHD symptoms significantly worsened during the lockdown (Zhang et al., 2020a). In a survey study in Italy (April 2020, $N = 527$), parents reported that respectively 36% and 42% of children diagnosed with an autism spectrum disorder (ASD) experienced more intense and more frequent behavioral problems compared to the period before the pandemic (Colizzi et al., 2020). Further, Turkish children diagnosed with ASD reported more sleep problems during the home confinement period which mediated autism symptom severity (May 2020, $N = 46$)) (Turkoglu et al., 2020). In another Turkish study that included 87 ASD patients (aged 3 to 29 years old), it was found that parents' anxiety levels were significantly correlated with the child's total score on the ABC (Aberrant Behavior Checklist). Half of the parents reported that their children became more aggressive, around one third of the parents reported sleep and appetite changes in their children and a quarter of the parents reported that their child's tics increased, or new tics emerged (Mutluer et al., 2020).

Conclusion: Overall, people with existing psychiatric disorders are experiencing a detrimental impact on their mental health from the COVID-19 pandemic, for example in OCD and PTSD, which requires close monitoring in clinical practice. The COVID-19 pandemic, however, does not seem to have further increased symptom severity in adult patients with depressive and anxiety disorders compared to their pre-pandemic levels (Pinkham et al., 2020);(Pan et al., 2021). Longitudinal observations with adequate time of follow-up suggest an increased risk for suicidality associated with the pandemic, even though there are conflicting reports. Regarding children and adolescents diagnosed with a psychiatric disorder, studies have generally reported a worsening of symptoms in young patients with eating disorders, obsessive compulsive disorders, and neurodevelopmental disorders such as ADHD and ASD. Severe mental illness in turn has been shown to represent an important vulnerability factor for COVID-19 infection. Basing on the increased vulnerability to COVID-19 in psychiatric patients,

several European countries have prioritized them for vaccination. Many other countries are currently evaluating this option (De Picker et al., 2021). See Table 6. for an overview of findings from cross-sectional and longitudinal studies on the impact of COVID-19 on stress resilience and mental health in patients with a psychiatric disorder.

8. COVID-19 patients

Previous SARS and MERS pandemics have shown that infection with the virus itself can be associated with increased symptoms as well as new diagnoses/symptoms of anxiety, depression, impaired memory, fatigue and insomnia in the acute as well as post-illness phase, and there is burgeoning evidence for substantial psychiatric symptoms related to COVID-infection (Rogers et al., 2020; Taquet et al., 2021). An electronic health record network cohort study using data from 69 million individuals showed that in the three months following testing positive for COVID-19, 1 in 5 survivors was recorded as having a first time diagnosis of anxiety, depression or insomnia. This was about twice as likely as for other groups of patients in the same period (Taquet et al., 2021). Furthermore, Horn et al. found that the prevalence of PTSD in patients with COVID-19 was around 6.5%, and a similar rate was also reported in COVID-19 patients discharged from hospitals in Wuhan (Horn et al., 2020). In an Italian cross-sectional study (April - October 2020) that included 381 patients who had recovered from COVID-19 within 30 to 120 days, a PTSD prevalence of 30.2% was reported after acute COVID-19 infection (Janiri et al., 2021). It is crucial to determine protective factors increasing resilience against mental health impairment following infection with COVID-19. This is illustrated by findings in a sample of 296 Chinese patients with mild symptoms of COVID-19, where higher resilience measured with the Connor-Davidson Resilience Scale was correlated with lower anxiety ($r = -0.391$, $p < 0.001$) and depression ($r = -0.472$, $p < 0.001$) scores. Patients with high resilience (upper 27%) were much less likely to display symptoms of anxiety (OR = 0.362, $p < 0.001$) or depression (OR = 0.301, $p < 0.001$) (Zhang et al., 2020b). Education about disease-related facts, emotional support and confidence of rehabilitation may enhance resilience in COVID-19 affected patients (Zhang et al., 2020b). Following up on these first data, longitudinal studies correcting for potential confounders such as pre-existing mental disorders, concomitant somatic disorders, severity of infection, degree of physiological compromise, immunological response, extent of medical interventions and socioeconomic situation, are warranted to further elucidate the role of resilience and its determining factors in promoting mental health in COVID-19 patients in order to develop targeted preventive interventions strengthening coping skills, self-efficacy, will power, daily routines and opportunities to share the emotional burden (Richards and Scowcroft 2020).

Conclusion: In sum, given the high risk of psychiatric sequelae of COVID-19 infection, preventive measures promoting mental health as well as intensified screening for symptoms of mental disorders should be routinely implemented in the standard care of COVID-19 patients to increase resilience towards mental disorders particularly in this patient group. Table 7 presents findings from cross-sectional and longitudinal studies on the impact of COVID-19 on stress resilience and mental health in COVID-19 patients.

9. Interindividual differences in stress resilience: implications for the pandemic

From the previous sections it is apparent that the effects of the pandemic, either related to COVID-19 itself or the associated measures, are surprisingly heterogeneous across populations. Trajectories of mental distress varied markedly by resilience level during the early months of the COVID-19 pandemic (Riehm et al., 2021). It is thus of paramount importance to understand which individuals are resilient or vulnerable to apply a personalized medicine approach (Willis and Lord, 2015). This approach harnesses the individual's genetic, genomic, proteomic, clinical, socioeconomic and lifestyle information to identify the factors causing the differential resilience/vulnerability to the virus. Such information allows to define resilient/vulnerable subpopulations, to refine targeted therapeutic strategies and to develop an effective public health approach. A meta-analysis examining 68 studies comprising 288,830 participants from 19 countries on factors associated with psychological distress during the COVID-19 pandemic (December 2019 - July 2020), showed that being female, being younger than 35 years old, living in rural areas, lower socioeconomic status, higher COVID-19 infection risk, longer social media exposure and having pre-existing physical or mental conditions were associated with higher anxiety and depression odds (Wang et al., 2020c). Higher social/family support, physical activity and positive coping strategies were associated with lower odds of anxiety and depression and thus a reduced risk of psychological distress (Wang et al., 2020c).

With regard to mental health, psychological attitudes towards how to manage the risk of infection, as well as towards specific medical, socioeconomic, personality and lifestyle factors, have been suggested to be key for the individual's resilience to distress and psychiatric disorders during a pandemic (Chen and Bonanno, 2020; WHO, 2020; Zager Kocjan et al., 2021). Individual trait resilience and well-being scores, measured respectively with the 10-item Connor-Davidson Resilience Scale and the Recovery from War Scale, have been found to predict effective coping with the COVID-19 threat (Kimhi et al., 2020; Ran et al., 2020). In addition, strategies aimed at reducing psychological distress such as paying attention to a healthy lifestyle, social support, good quality of sleep, acceptance of negative emotions, and avoidance of suppression and substance abuse, have been suggested to increase psychological resilience and may be key in coping with the COVID-19 related distress (Bozdag and Ergun, 2020; Petzold et al., 2020). By contrast, loneliness, or negative psychological reactions, including panic response, hysteria, hopelessness and desperation, have been associated with negative outcomes, including suicidal ideation (Killgore et al., 2020a; Lee, 2020; Serafini et al., 2020; Thakur and Jain, 2020). Although the impact of the pandemic is still under investigation and initial large scale data analysis show that suicide numbers have remained largely unchanged or declined in the early months of the pandemic compared with the expected levels based on the pre-pandemic period in high-income and

Table 6 The impact of COVID-19 on stress resilience and mental health in patients with a psychiatric disorder.

Study	Population	Time period/ wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
Adults with a psychiatric disorder						
Lee, S. W. et al., S.W. 2020	South Korean adult patients with non-affective or affective disorders with psychotic features	Jan 1 - May 15 2020,	Cross-sectional, $N = 164,540$ individuals without a mental illness (mean age 46.2 years ($\pm$18.3) and $N = 51,878$ with a mental illness (mean age 61.6 years ($\pm$19.2)	The associations between mental illness and the likelihood of a positive COVID-19 test result and the clinical outcomes of COVID-19	Being older than 20 years, presence of a SARS-CoV-2 test during the study period	1391 (3.0%) people without a mental illness and 1383 (2.9%) of those with a mental illness tested positive for COVID-19. People with a previous diagnosis of a mental illness had the same risk for testing positive for COVID-19 as people with no history of mental illness in a nationwide cohort from South Korea.
Li, L. et al., L. 2020	US adults, hospitalized COVID-19 positive patients	Two waves; T1: February 15 - April 25 2020,, and T2: May 27 2020,	Cohort, $N = 1685$	The association between having any prior psychiatric diagnosis and COVID-19 related mortality of hospitalized patients with COVID-19	Being hospitalized for COVID-19	Patients with a prior psychiatric diagnosis while hospitalized for COVID-19 had a higher mortality rate compared those without a psychiatric disorder (hazard ratio, 1.5; 95% CI, 1.1-1.9; $P = 0.003$).
Wang, Q. et al., 2020	US adult patients	Up to July 2020	Case-control, $N = 61,783,950$	The impact of a recent (within past year) diagnosis of a mental disorder - including attention-deficit/hyperactivity disorder (ADHD), bipolar disorder, depression and schizophrenia - on the risk for COVID-19 infection and related mortality and hospitalization rates	Having an electronic health record	Patients with a recent (within past year) diagnosis of a mental disorder had a significantly higher risk for COVID-19 infection as compared to patients without mental disorders, and also present a worse out- come as evidenced by higher rates of hospitalization and death.
Taquet, M. et al., M. 2021	US adult patients (anonymised data from electronic health records in 54 health-care organisations in the US)	January 20 - August 1 2020,	Cohort, $N = 69.8$ million ($n = 62,354$ with COVID-19, mean age 49.3 years ($\pm$19.7), 55.4% female)	Bidirectional associations between COVID-19 and psychiatric disorders	Having an electronic health record	Survivors of COVID-19 appear to be at increased risk of psychiatric sequelae, and a psychiatric diagnosis might be an independent risk factor for COVID-19.

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Study	Population	Time period/ wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
Carpiniello et al., 2020	Italian Community Mental Health Centres (CMHC) and General Hospital Psychiatric Wards (GHPW)	April 1-11 2020	Cross-sectional, $N = 71$ (52.9%) of the 134 (MHDs) and $N = 107$ (32.6%) of the 318 GHPWs	The impact of the current emergency on the activities of the Italian Mental Health Departments	Being included in the list of Mental Health Departments, updated annually by the Italian Society of Psychiatry	The pandemic has led to a drastic reduction in levels of care, which may produce a severe impact on the mental health of the population.
Robles-Bello et al., 2020	Spanish adults in a sample affected by the COVID-19 pandemic	April 15-26 2020	Cross-sectional, $N = 1345$ (15.57% aged 18-28 years, 17.03% aged 29-39 years, 18.01% aged 40-49 years, 16.95% aged 50-59 years, 17.36% aged 60-69 years, 15.08% aged $\geq$70 years, 63.35% female)	The level of resilience of the general Spanish population exposed to a traumatic situation by the COVID-19 pandemic	Being 18 years or older, having a Spanish nationality, being a resident in Spain, having read the information sheet and accepted the informed consent, having completed the questionnaire.	The Spanish population exposed to confinement presented high levels of resilience, but no relevant post-traumatic growth took place. Having a higher academic level, being autonomous), along with self-efficacy) and to a lesser extent optimism predicted a resilient outcome.
Burrai et al., 2020	Italian adult patients in Residential Rehabilitation Communities and healthy controls	April - May 2020 (precise period unknown)	Cross-sectional, $N = 77$ psychiatric patients (mean age 46.61 years ($\pm$12.81), 33.8% female) and $N = 100$ healthy controls (mean age 46.40 ($\pm$11.52), 50% female)	The psychological and emotional impact of isolation on patients in these psychiatric communities, compared to healthy controls	Being 18 years or older and having a diagnosis of at least one psychotic disorder	Statistically significant differences were observed between psychiatric patients and controls on Anxiety, Stress, Worry, and Risk Perception variables.
Horn et al., 2020	French adult patients infected by COVID-19	March 17 - May 11, 2020	Cross-sectional, $N = 180$ (mean age 53.0 ($\pm$16.0))	The prevalence of PTSD in patients with laboratory-confirmed COVID-19	Having a laboratory-confirmed diagnosis of COVID-19, being 18 years or older and being willing to participate	Results showed that 6.5% of the patients presented with probable PTSD. Psychotropic medication, hospitalization, and distress during the acute phase of COVID-19 were significantly associated with the severity of the PTSD symptoms.

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Study	Population	Time period/ wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
Rutherford et al., 2021	US adult patients affected by PTSD	April 1 - May 8 2020,	Cross-sectional, $N = 76$ ($N = 46$ with PTSD (mean age 62.5 years ($\pm$9.0)) and $N = 30$ trauma-exposed comparison subjects; TE (mean age 67.4 ($\pm$9.4))	PTSD symptoms, social isolation and loneliness among older adults with PTSD compared to TEs	Being 50 years or older, being currently diagnosed with PTSD, having a PTSD duration of at least 6 months, having a Post-traumatic Stress Disorder Checklist (PCL-5) score $\geq$33, having a score of $\geq$25 on the Clinician-Administered PTSD Scale for DSM-5 (CAPS-5)	PTSD symptoms significantly declined among PTSD participants relative to TEs. Sources of resilience may exist based on experience with prior traumas as well as increasing age promoting more adaptive coping styles.
Pinkham, A. et al., 2020	US adult patients affected by severe mental illness	April 3, - June 4 2020,	Longitudinal, $N = 148$ ($N = 92$ with schizophrenia spectrum illnesses and $N = 56$ with affective disorders)	To compare the severity of pre-pandemic symptoms and affective experiences to current symptoms	Having a diagnosis of schizophrenia, schizoaffective disorder, bipolar disorder (I or II) with or without psychotic features or major depression with psychotic features	There were no significant changes in mood experiences or psychotic symptoms over time, and sleep duration was also unaffected.
Ma et al., 2020	Chinese adult schizophrenic patients medically isolated from 10 January 2020 to 30 April 2020, due to having close contact with COVID-19 patients at Wuhan Mental Health Center (aged between 20 and 70 years old)	January 10 - April 30 2020,	Cross-sectional, $N = 30$ patients with schizophrenia were recruited from Wuhan Mental Health Center (isolation group) $N = 30$ patients matched with the isolation group recruited from another branch of Wuhan Mental Health Center as controls	To explore the impact of social isolation due to COVID on common inflammatory indicators and psychological characteristics	Having been in close contact with COVID-19 patients, not having a COVID-19 infection after isolation and screening, having been medically isolation for $\geq$ 14 days, being diagnosed with schizophrenia in accordance with the Diagnostic and Statistical Manual of Mental Diagnostic criteria (DSM-VI), being hospitalizatized for $\geq$2 years before isolation, being between 20 and 70 years old	Social isolation led to worse anxiety and sleep quality. No effect on inflammatory parameters.
Pan et al., 2021	Dutch adults with and without depressive, anxiety, or obsessive-compulsive disorders (three cohorts:1) the Netherlands Study of Depression and Anxiety (NESDA), 2) the Netherlands Study of Depression in Older Persons (NESDO), and 3) the Netherlands Obsessive Compulsive Disorder Association Study (NOCDA)	April 1 - May 13 2020,	Longitudinal, NESDA: $N = 2329$ individuals with a depression or anxiety disorder, $N = n = 652$ controls NESDO: $N = 378$ individuals with a depressive disorder, $N = 132$ controls NOCDA: $N = 419$ individuals with a lifetime diagnosis of obsessive-compulsive disorder	The impact of the COVID-19 pandemic on mental health in people with pre-existing mental health disorders	NESDA: being aged 18=65 years; NESDO: being 60 years or older; NOCDA: being 18 years or older	Although people with depressive, anxiety, or obsessive-compulsive disorders scored higher on all four symptom scales than did individuals without these mental health disorders, both before and during the COVID-19 pandemic, they did not report a greater increase in symptoms during the pandemic

Table 6 (*continued*)

Study	Population	Time period/ wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
Tanaka & Okamoto, 2021	Japanese general population	February - June 2020 (first wave of pandemic) and July - October 2020 (second wave of pandemic)	Cross-sectional, $N = 126$ million (data derived from suicide statistics published by the Ministry of Health, Labour, and Welfare)	Suicide mortality during the pandemic in the Japanese population	Unknown	The suicide rate declined substantially during the first wave of the COVID-19 pandemic (February to June 2020), but increased rapidly during the second outbreak (July to October 2020). The COVID-19 pandemic affected almost every community and citizen concurrently.
Nomura et al., 2021	Japanese general population	December 2010-September 2020 (precise period unknown, montly mortality data was obtained from the National Police Agency)	Cross-sectional, N: Unknown	Suicide mortality during the pandemic in the Japanese population	Unknown	For women, excess deaths of 110.00–160.75 (percent excess 22.08–32.26) were observed in July 2020, 96.00–163.56 (19.34–32.95) in August 2020, and 95.00–161.00 (19.83–33.61) in September 2020. No excess deaths from suicide were observed before 2020. For men, no excess deaths were found during the same period.
Sáiz et al., 2020	General Spanish population aged 18 and older	March 19 −26 2020	Cross-sectional, $N = 21,207$ (mean age 39.7 years (±14.0), 69.6% female)	The prevalence of passive suicidal ideation in a sample of the general Spanish population early in the COVID-19 pandemic and lockdown factors associated with suicidal thoughts	Being 18 years or older	Being of female sex, married or living as married, and working were protective factors against passive suicidal ideation while risk factors were very low income, having elderly dependents, and having a personal history of past/current mental disorder.
Iob, E. et al., 2020 (144)	UK general population (COVID-19 Social Study)	March 21- April 20 2020,	Cross-sectional, $N = 44,775$ (17.5% aged 18–29 years, 23.2% aged 30–44, 26.9% aged 45–49, 32.4% aged >60 years, 51.0% female)	Patterns of abuse, self-harm and thoughts of suicide/self-harm in the UK during the first month of the COVID-19 pandemic	Presence of data on abuse, self-harm and thoughts of suicide or self-harm on at least one occasion	The reported frequency of abuse, self-harm and thoughts of suicide/self-harm was higher among women, Black, Asian and minority ethnic (BAME) groups and people experiencing socioeconomic disadvantage, unemployment, disability, chronic physical illnesses, mental disorders and COVID-19 diagnosis.

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Study	Population	Time period/ wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
Children and adolescents with a psychiatric disorder						
Graell et al., 2020	Patients undergoing treatment in the outpatient clinic, day hospital, and the inpatient program of the Child and Adolescent Eating Disorders Unit (CAEDU) of the Hospital Infantil Universitario Niño Jesús in Madrid.	March 16 - May 10, 2020	Cross-sectional, $N = 365$ (1818 outpatient consultations; 73.10% remotely and 26.9% face-to-face)	The efficacy of a combined teletherapy program aimed at allowing continuity of care for children and adolescents with an eating disorder	Undergoing treatment in the Eating Disorders unit at the time of state-decreed confinement and during the 8-week lockdown period	Almost half of the children and adolescents studied experienced reactivation of eating disorder symptoms despite treatment, and severe patients (25%) presented self-harm and suicide risk,
Nissen et al., 2020	Danish children and adolescents, newly diagnosed with OCD (clinical group) and Danish children and adolescents who were diagnosed years ago and completed their primary treatment (survey group)	April–May 2020 (precise period unknown)	Cross-sectional, $N = 65$ (first sample, clinical group, mean age 14.9 ($\pm$2.66)); $N = 37$ (second sample, survey group, mean age 14.14 years ($\pm$2.79))	The immediate effect of COVID-19 pandemic on children and adolescents with obsessive compulsive disorder (OCD)	Having been diagnosed with OCD	In both samples, but with an effect more pronounced in the survey group, participants experienced a worsening of their OCD, anxiety, and depressive symptoms
Tanir et al., 2020	Turkish children and adolescents who had been diagnosed with OCD	September 2019 to April 2020 (precise period unknown)	Cross-sectional, $N = 61$ (mean age 13.62 years ($\pm$2.72), 44.3% female)	The effects of COVID-19 pandemic and related confinement on symptom profile, symptom severity and exacerbation of obsessive-compulsive disorder (OCD)	Being diagnosed with OCD and having a Children's Yale-Brown Obsessive Compulsive Scale (CY-BOCS) score from before the pandemic period	Young subjects with OCD developed additional symptoms and worsen already existing symptoms of OCD during COVID-19 pandemic. There was a significant relationship between the change in CY-BOCS scores with talking/searching in the social environment about COVID-19, daily preoccupation about COVID-19, duration of OCD diagnosis and diagnosis of COVID-19 in someone familiar.

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Study	Population	Time period/ wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
Zhang, J. et al., 2020	Chinese children with ADHD diagnosis	Not specified	Cross-sectional, $N = 241$ (mean age 9.43 years (±2.39), 19.5% female)	Mental health related conditions of children with ADHD during the COVID-19 outbreak	Being diagnosed with ADHD	During the COVID-19 outbreak, children's ADHD symptoms worsened significantly compared to normal state. Data were reported by parents, and medication status was not known.
Colizzi et al., 2020	Italian children with ASD	April 6–20 2020	Cross-sectional, $N = 527$ (mean age 13.0 years (± 8.1))	The impact of the COVID-19 pandemic on Autism Spectrum Disorder (ASD) individuals	Being diagnosed with ASD by healthcare professionals affiliated with the Veneto Autism Spectrum Disorder Regional center at the Integrated University Hospital of Verona	The COVID-19 outbreak increased difficulties among autism spectrum disorder individuals.
Turkoglu et al., 2020	Turkish drug-naive children diagnosed with ASD	May 7–14 2020 (during the fifth week following commencement of home confinement)	Cross-sectional, $N = 46$ (mean age 7.89 years ()range 4–17 years), 17.39% female)	The relationship between chronotype preference/sleep problems and symptom severity of children with Autism Spectrum Disorder (ASD) during the confinement and social isolation of the COVID-19 outbreak	Being diagnosed with ASD and having been regularly monitored and received conventional assessment forms during the 2 months before the commencement of home confinement	ASD exhibited significantly greater sleep problems and chronotype score (eveningness) during the home confinement period compared to non-home confinement. Children with ASD forced into home confinement due to the COVID-19 pandemic showed also increased ASD symptoms.
Mutluer et al., 2020	Turkish individuals with ASD (aged 3–29 years old)	Not specified	Cross-sectional, $N = 87$ (mean age 13.96 years (±6.1), 17% female)	Response of individuals with ASD to COVID-19 in terms of comprehension and adherence to implemented measure and changes in their behavioural problems	Having been diagnosed with ASD according to DSM-5 criteria by child psychiatrists with over 10 years of experience in ASD	ASD-related behaviours, sleep quality, and hypersensitivity changed significantly from before the pandemic to during the pandemic. COVID-19 inflicted important challenges to individuals with ASD and their caregivers.

Table 7 The impact of COVID-19 on stress resilience and mental health in COVID-19 patients.

Study	Population	Time period/Wave	Study type and sample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
Janiri et al., 2021	Italian patients who presented to the emergency department with COVID-19 and recovered from COVID-19 infection	April 21 - October 15 2020,	Cross-sectional, $N = 381$ (mean age 55.26 years ($\pm$ 14.86), 43.6% female)	PTSD prevalence after severe COVID-19 infection	Having to meet PTSD criteria, in addition to traumatic event exposure (criterion A), having at least 1 DSM-5 criterion B and C symptom and at least 2 criterion D and E symptoms	A PTSD prevalence of 30.2% was observed after acute COVID-19 infection. Associated characteristics were female sex, history of psychiatric disorders, and delirium or agitation during acute illness. In the PTSD group, more persistent medical symptoms, were often reported by patients after recovery from severe COVID-19.
Zhang, J. et al., 2020	Chinese adult patients with mild symptoms of COVID-19	March 3 –5 2020	Cross-sectional, $N = 296$ (2.7% aged 18–20 years, 53.0% aged 21–40 years, 40.5% aged 41–60 years, 3.7% aged $\geq$ 61 years, 41.6% female)	Resilience, anxiety and depression among patients with mild symptoms of COVID-19	Being diagnosed with COVID-19, having stayed in FangCang Hospital and received relevant treatment (e.g., oxygen therapy and antiviral therapy), being 18 years or older, not having a history of mental illness, a severe cognitive impairment and/or audiovisua impairment, poor physical condition, or having participated in other relevant studies	A small number of the patients in this study had above threshold anxiety and depression. The mean total resilience score of the participants was slightly below the normal level of ordinary Chinese adults. Resilience was inversely associated with and was a protective factor for both anxiety and depression.

upper-middle-income countries it is plausible that more accurate figures will be detected in the long-term even after the pandemic will decrease its burden globally. Mental distress can be exacerbated by being quarantined (Xin et al., 2020). It is worth noting that young people have reported to experience greater psychological distress than adults (McGinty et al., 2020; Pierce et al., 2020; Varma et al., 2020). Unfortunately, to the best of our knowledge, no data on potential genetic, epigenetic, or brain function markers of resilience to mental illness in the face of the pandemic have been published yet. However, it can be hypothesized that neurobiological factors usually involved in the stress response, emotion-regulation, and the ability to adapt to new life conditions, such as immune system activation, hypothalamic-pituitary-adrenal axis activity and neural plasticity processes, might be involved (Branchi and Giuliani, 2020; Zorn et al., 2017).

The three-dimensional vulnerability-stress-coping model may help understanding risk and resilience for mental disorders in relation to stress during the COVID-19 pandemic. This gene x environment x coping (G x E x C) model has been proposed to include the three factors a) genetic vulnerabil-

Table 8 Interindividual differences in stress resilience: implications for the pandemic.

Study	Population	Time period/Wave	Study type and ample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
Riehm et al., 2021	US adults	Ten waves; baseline: March 10–31 2020 and nine follow-up waves conducted between April 1 - August 4 2020,	Longitudinal, $N = 6008$ (12.3% aged 18–29 years, 39.5% aged 30–49 years, 27.2% aged 50–64 years, 20.9% aged ≥65 years, 51.0% female, 64.1% White 11.6% Black, 15.5% Hispanic/Latino, 8.8% other)	The association between resilience and trajectories of mental distress during the COVID-19 pandemic	Being a participant of the Understanding America Study (UAS)	16.6% of the participants reported low resilience, 66.2% reported normal resilience, and 17.2% reported high resilience. Trajectories of mental distress varied markedly by resilience level during the early months of the COVID-19 pandemic, with adults reporting low or normal levels of resilience experiencing approximately a twofold increase in the odds of mental distress, whereas adults reporting high resilience reported no change in mental distress.
Zager Kocjan et al., 2021	Slovene adults	March 2020 (precise period unknown)	Cross-sectional, $N = 2722$ (mean age 36.40 years (±13.10), 74.90% female)	Resilience, personality traits and psychological functioning during the COVID-19 pandemic	Unknown	Resilience fully or partially mediated the relationship of all the Big Five personality traits (except extraversion) with psychological functioning.
Kimhi et al., 2020	Jewish Israelis	Unknown	Cross-sectional, $N = 1346$ (mean age 42.00 years (±16.35), 62.0% female)	To investigate the extent to which individual resilience, well-being and demographic characteristics may predict two indicators of Coronavirus pandemic: distress symptoms and perceived danger	Unknown	Significant negative correlations were found between individual/community resilience and sense of danger (−0.220 and −0.255 respectively; $p < .001$) and distress symptoms (-0.398 and −0.544 respectively; $p < .001$). Individual resilience and well-being showed to be the first and foremost predictors of COVID-19 anxiety.

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Table 8 (*continued*)

Study	Population	Time period/Wave	Study type and ample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
Ran et al., 2020	Chinese citizens	February 23 - March 2 2020,	Cross-sectional, $N = 1770$ (mean age 28.70 years ($\pm$10.64), 666.9% female	The relationship between psychological resilience and mental health (depression, anxiety, somatization symptoms) among the general population in China	Being a citizen of the different provinces of China affected by COVID-19 from February 23 2020, to March 2 2020,, not being diagnosed with emotional or mental disorders, not being a newly diagnosed or suspected COVID-10 patient, not having had, not being a medical (COVID-19) staff member, not having a family member affected by COVID-19	The prevalence of depression, anxiety, somatization symptoms was found to be 47.1%, 31.9%, 45.9%, respectively. Psychological resilience was negatively correlated with depression (standardized $\beta = -0.490$, $P < 0.001$), anxiety (standardized $\beta = -0.443$, $P < 0.001$), and somatization symptom scores (standardized $\beta = -0.358$, $P < 0.001$), while controlling for confounding factors..
Petzold et al., 2020	German general population	March 27 – April 6 2020,	Cross-sectional, $N = 6509$ (mean age 36.2 years ($\pm$11.65), 70.1% female)	The negative impact on mental health in the current COVID-19 pandemic	Being of 18 years or older, being a resident in Germany, being able to complete the questionnaire in German	Over 50% expressed suffering from anxiety and psychological distress regarding the COVID-19 pandemic.
Bozdag, F. & Ergun, N., 2020	Turkish health-care workers	April 6 – 10 2020	Cross-sectional, $N = 214$ (mean age 33.29 years (6.82$\pm$), 56.1% female)	Psychological resilience of healthcare workers	Unknown	Differences between psychological resilience of women and men were statistically significant. Having children and being a doctor negatively predicted psychological resilience. Occupation, worry about becoming infected by the virus and quality of sleep significantly predicted the psychological resilience of healthcare professionals.

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Table 8 (*continued*)

Study	Population	Time period/Wave	Study type and ample size	Objective(s)/Main outcomes	Inclusion criteria	Main findings/Summary
Killgore, W. D. S. et al., 2020	US adults aged 18–35 years old	April 9–10 2020	Cross-sectional, $N = 1013$ (age range 15–35 years, 55.97% female)	Loneliness in the US Population, related to COVID-19	Unknown	Loneliness was elevated, with 43% of respondents scoring above published cut-offs, and was strongly associated with greater depression and suicidal ideation.
Xin et al., 2020	Chinese students (26 universities in 16 Chinese cities)	February 1–10 2020	Cross-sectional, $N = 24{,}378$ (mean age 19.9 years ($\pm$1.6), 67.7% female)	The associations between mandatory quarantine status and negative cognitions and mental health	Being a full-time students of one of the selected universities, and being able to read and write Chinese	Mandatory quarantined status was significantly and positively associated with perceived discrimination (Cohen's $d = 0.62$), perceived high/very high risk of infection (OR = 1.61), emotional distress (Cohen's $d = 0.46$), probable depression (OR = 2.54), and self-harm/suicidal ideation (OR = 4.98).
Varma et al., 2020	Adults from 63 countries	April 9 - May 25 2020,	Cross-sectional, $N = 1653$ (mean age 42.90 years ($\pm$ 13.63), 67.7% female, 61.2% Caucasian of Caucasian mixed, 20.2% Asian or Asian Indian, 3.6% Hispanic or Latino, 1.7% African or African American, 2.0% self-described)	The impact of the COVID-19 pandemic on psychological distress	Unknown	Over 70% of the respondents had greater than moderate levels of stress, with 59% meeting the criteria for clinically significant anxiety and 39% reporting moderate depressive symptoms.

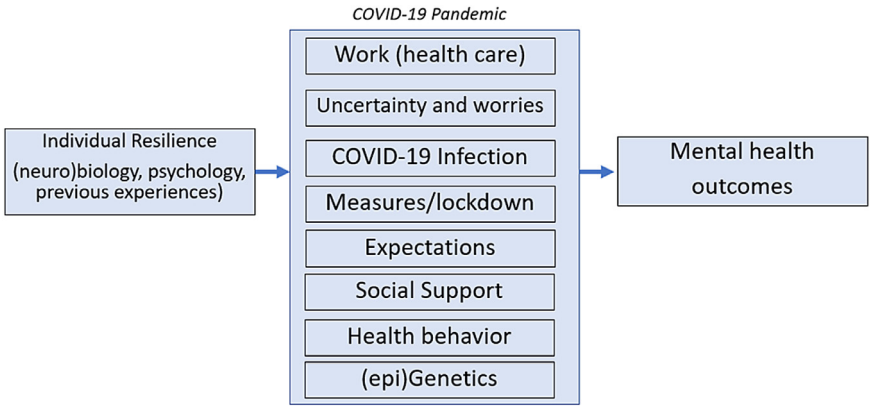

Fig. 1 Resilience and mental health related to the COVID-19 pandemic.

ity, b) risk-increasing external stressors and c) resilience-increasing coping mechanisms, such as self-efficacy buffering the impact of a high genetic vulnerability and/or adverse environment. Exemplary studies have demonstrated this complex, three-fold interaction regarding risk or resilience towards anxiety phenotypes (Schiele et al., 2020, 2016). Finally, epigenetic mechanisms at the interface between biology and biography and impacting on stress-response and emotion-regulating capacities might add another level to confer individual risk as well as resilience towards mental disorders under adverse and advantageous environmental conditions (Vinkers et al., 2015). Therefore, an extended (Epi) G x E x C model might prove useful in informing future personalized preventive interventions increasing resilience towards mental disorders. At the same time, existing hypotheses as the stress inoculation or match/mismatch hypothesis for psychiatric disorders may help to understand why selected population groups show increased resilience levels, for instance due to previous life experiences that now enable them to deal appropriately with the current challenges (Nederhof and Schmidt, 2012; Schmidt, 2011).

Conclusion: There is an urgent need for a personalized approach when it comes to identifying individuals at risk or resilient for the stressful effects of the COVID-19 pandemic. The effects of stress and the resilience capacity are dependent on (neuro)biological, psychological, and environmental factors and are heavily dependent on an individual's unique context. Intensified research into (epi)genetic, proteomic, immunological, clinical, neuropsychological, socioeconomic and lifestyle factors conveying mental disorder risk or resilience in the context of the present pandemic is urgently warranted to provide individually tailored and thus most efficient resilience-increasing preventive measures. Findings from cross-sectional and longitudinal studies on interindividual differences in stress resilience are presented in Table 8.

10. Conclusions and future perspective

We believe resilience research is in a unique position to make a significant contribution to understand the psychological and psychiatric impact of this pandemic and inform future clinical and research directions. This is not limited to the current COVID-19 pandemic but also applies to other local or global challenges. From the current literature, a surprising level of resilience is apparent across populations, even though there are individuals and groups that are at increased risk for the stressful effects of the COVID-19 pandemic (**Fig. 1**). Nevertheless, firm conclusions cannot be drawn as most of the current literature has major methodological limitations. Most studies on stress resilience and mental health outcomes during the pandemic are observational, cross-sectional, using convenience samples with often rather small sample sizes and rather limited assessment of contextual and personal characteristics that are essential to understand stress vulnerability and resilience. Interpretation of observational studies from non-representative samples is likely to suffer from bias, particularly regarding collider bias (Griffith et al., 2020). There is a stark contrast between the very limited number of extensive longitudinal studies with pre-pandemic assessments and a broad array of outcomes, and the vast number of cross-sectional studies with one or two outcomes. Where newer cohorts lack baseline data from before the pandemic, large established cohorts move relatively slowly and mostly sample infrequently. This makes more fine-grained assessments of resilience and mental health more challenging. Finally, there is lack of observational data on how the general public and patients with psychiatric disorders actually deal with self-care, nutrition, physical activity or restorative sleep during confinement (Balanza-Martinez et al., 2020). Thus, public policies will need to be informed by data gathered in observational studies of lifestyle behaviors during the compulsory isolation (Balanza-Martinez et al., 2020). This research gap has been partly filled by very recent data confirming that psychiatric patients, particularly those affected by depression and anxiety tended to have higher levels of psychopathological distress (Sole et al., 2021), and that the presence of depressive symptoms was a predictor of poorer resilience (Verdolini et al., 2021).

Nevertheless, studies during the pandemic consistently show that children and young people are the most vulnerable group with increased psychological distress, probably because their needs for social interactions are stronger. Moreover, young women appear to be more vulnerable than

young men, and parents with young children appear to be at particularly high risk for mental health problems. However, these are rather broad conclusions which cannot be used at the individual level. There is still an urgent need to identify individuals and populations with higher risk of psychological distress during the COVID-19 pandemic to offer targeted mental health care and to improve social support, physical activity, and coping strategies in these individuals. These approaches are needed to boost resilience factors protecting the individual against psychological distress. For example, social support from and connectedness with family, friends, and a special caring loved one were each independently associated with greater resilience (Killgore et al., 2020b; Nitschke et al., 2020) (South et al., 2020) (Prime et al., 2020). Moreover, there seems to be a role for media with regard to resilience and mental health during the pandemic. Nuanced and balanced news coverage around the COVID-19 pandemic is essential in order that nocebo effects as a result of negative and alarming news coverage occur (Bendau et al., 2020a). Next, employers are taken up on their promise to assist their employees by building up resilience strategies at the organizational level. It remains to be seen how stress resilience will be shaped because of longer-term effects of the pandemic, or when society will need to find a new balance *after* the lockdown and pandemic. This is particularly pressing considering possible economic sequelae that will emerge while at the same time individuals will be forced to change from a lockdown situation to a more proactive attitude when all societal processes will start to function again.

About the methodological quality of the resilience literature during the COVID-19 pandemic, several lessons can be learned for future research to provide a more detailed and fine-grained picture, with possibilities for targeted prevention and intervention. First, the use of longitudinal data and large samples is important to identify potentially causal relationships, and changes over time (Kalisch et al., 2017). How we respond to stress is a surprisingly dynamic process. Stress initiates a cascade of behavioral, (neuro)biological, and physiological changes. To this end, we need prospective data of adequate duration and of sufficient temporal resolution to observe (dis)continuous changes in resilience. Second, concerning outcomes and context, biological, psychological, and environmental data should be combined and integrated to understand the impact of (pandemic-related) stress at different levels with understanding of the individual's unique context. Third, we would encourage interdisciplinary collaborations, for example between physicians treating COVID-19 patients, psychiatrists, sociologists, advanced data experts, and neurobiologists. Fourth, we need not only to identify how stress resilience is shaped during a (prolonged) pandemic, but also develop efficient mental health interventions at a governmental, institutional, and individual level to minimize its long-term consequences. In conclusion, it is apparent that we have shown a remarkable level of resilience during the prolonged COVID-19 pandemic, but that large interindividual differences exist. Above all, it provides an opportunity but also an imperative for scientists and clinicians to work together to help understanding and addressing the pandemic.

Contributions

CV wrote the first draft. All authors provided critical input and revisions.

Conflicts of Interest

There are no conflicts of interest

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