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The Robert Koch Institute's COVID-19 lessons learned process: managing the COVID-19 pandemic in Germany – social determinants, interactions with non-communicable diseases and long-term effects

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Abstract

Background: The COVID-19 pandemic has affected population health in various ways. There have been interactions with non-communicable diseases (NCDs). Furthermore, the risk of infection and the course of the disease have been influenced by social inequalities, and the negative consequences of containment measures have been distributed unequally across different social groups.

Methods: This article is based on a discussion paper produced collaboratively within the Department of Epidemiology and Health Monitoring at the Robert Koch Institute, which was discussed and expanded upon with experts during a 'COVID-19 Lessons-Learned-Workshop'. It presents empirical findings from the COVID-19 pandemic regarding consequences that extend beyond the course of the infection itself. NCDs, including mental health, Long COVID and social determinants, are presented in the context of the pandemic.

Results: During the pandemic, mental health in the population deteriorated, physical activity declined and the prevalence of obesity among children increased, amongst other things. In Germany, at least 6.5 per cent of people infected with SARS-CoV-2 experienced prolonged symptoms even after the infection, indicating the clinical picture of Long COVID. Risks for severe COVID-19 included, for example, chronic conditions and smoking. Socially disadvantaged population groups were more severely affected by both COVID-19 and the overall impact on NCDs. The COVID-19 pandemic was a 'syndemic', as risk factors and health problems interacted in complex ways and were also socially determined.

Conclusions: Support for psychosocial health should form part of pandemic management before, during and after an acute crisis. The same applies to addressing social inequality. In future crises, monitoring of (the impact on) NCDs and their risk factors should be ensured, research into post-infection syndromes expanded, and the measures taken critically reviewed.

Keywords: COVID-19 pandemic, SARS-CoV-2, Non-communicable diseases, Social inequality, Mental health, Public health, Social determinants of health, Post-infectious conditions, Germany, Obesity, Smoking

1. Introduction

In addition to manifesting as an acute infectious disease, the COVID-19 pandemic has affected public health in various other ways. Non-pharmaceutical interven-

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tion (NPI) measures, such as school closures and lockdowns, have slowed the spread of SARS-CoV-2, but have induced far-reaching changes to social life. Examples include reduced social contacts, changes to working life (e.g. through working from home) and restricted access to healthcare and preventive services. Consequently, the NPIs were associated with unintended negative health outcomes, for example through changes in health-related behaviours such as sport and physical activity, diet or substance use. Furthermore, they were linked to impaired mental health. The pandemic thus also had an impact on non-communicable diseases (NCDs). Socially disadvantaged individuals were affected more frequently and more severely by these indirect health consequences [1], for example through interactions with their working and housing conditions.

Social determinants also played a significant role in COVID-19 cases. In Germany, as in many other countries, the risk of SARS-CoV-2 infection and the likelihood of a severe course of the disease were influenced by structural social inequalities. This was due, for example, to increased occupational exposure to the virus, an increased risk of transmission – for instance, due to overcrowded housing conditions – and increased susceptibility (vulnerability to the pathogen) – for instance, due to pre-existing conditions [2].

Against this background, the COVID-19 pandemic can be understood as a 'syndemic' [3]. This term describes the co-occurrence of interacting risk factors and health problems in specific population groups, whereby these interrelationships are shaped by social factors and can disproportionately disadvantage certain social groups [2, 4, 5]. For example, NCDs, such as cardiovascular diseases, respiratory diseases or diabetes mellitus, as well as their risk factors, such as obesity, are associated with an increased risk of severe COVID-19. At the same time, the prevalence of these and other chronic conditions is higher in socially disadvantaged population groups. COVID-19 can exacerbate these underlying conditions, leading to mutually reinforcing interactions that may, at least in part, explain the unequal distribution of health outcomes from COVID-19 across the population [2]. Similar interactions have also been described in relation to mental health and the long-term health consequences of COVID-19 (Long COVID) [6]. At the same time, social determinants can also represent resources, for example in the form of social support and social capital. Community cohesion and trust in institutions have been shown to enable people to respond to and recover from crises. This has also been demonstrated in the context of the COVID-19 pandemic [7]. This article summarises empirical findings from the COVID-19 pandemic that address the interactions and consequences extending beyond the pandemic itself. NCDs, including mental health, Long COVID and the social determinants of health, are presented in the context of the COVID-19 pandemic, and conclusions are drawn for the management of future epidemic crises.

Key messages

- During the COVID-19 pandemic, mental health deteriorated, physical activity declined and the provision of care – for example, for people with mental health conditions – changed.
- Risk factors for severe COVID-19 included, for example, chronic conditions and smoking; socially disadvantaged population groups were more severely affected.
- In Germany, at least 6.5 per cent of those infected with SARS-CoV-2 developed symptoms of Long COVID.
- Future pandemic management should include measures to improve psychosocial health and to monitor the impact on NCDs and risk factors in the context of social determinants.
- It is foreseeable that disadvantaged population groups will continue to face a higher risk of adverse health effects in future crisis situations.

2. Methods

This article presents empirical findings from the COVID-19 pandemic, and a critical reflection on them resulting from a 'COVID Lessons Learned' process conducted by the Robert Koch Institute (RKI), which is described in more detail in the editorial [8]. The process, supported by external public health experts, served to reflect upon and scientifically analyse the experiences of the COVID-19 pandemic in Germany, with a particular focus on the RKI's areas of responsibility, extending beyond the infectious disease perspective. During a joint workshop in October 2025, recommendations were drawn up to ensure better preparedness for future pandemic events. This article was based on an internal discussion paper focusing on social determinants, the impact of the pandemic on NCDs and Long COVID, which had been collaboratively developed by the RKI's Department of Epidemiology and Health Monitoring. During the workshop, the paper was discussed with external experts from universities, non-university research institutes and academies, the (local) public health authorities/ departments and the Federal Ministry of Health. They represented expertise in the key areas of social epidemiology, child and adolescent health, the health of older people, mental health, healthcare research and Long COVID.

The workshop was structured by topics (the pandemic's impact on: Mental health, physical activity, obesity and diabetes, healthcare; NCDs as risk factors for COVID-19 infec-

tions and severe disease progression; Long COVID; the pandemic's impact on social inequalities in health chances). Key questions centred on the relevant evidence, potential data gaps, and the conclusions and recommendations to be drawn. There was also discussion on whether to prioritise certain key areas. In doing so, the assessments contained in the paper were examined by the participants regarding their validity (face validity). Aspects raised during the workshop and proposed amendments were incorporated into the paper. The consolidated results are presented below. However, for reasons of manageability and feasibility, not all possible consequences of the pandemic are discussed in depth; instead, various particularly relevant health issues are addressed by way of example.

3. Results

3.1 General suggestions from the workshop regarding the presentation and focus of the results

There was a consensus amongst the experts that, for crisis management – including when the primary focus is on communicable diseases – it is essential to take greater account of NCDs and social determinants. Considering NCDs and health behaviour is also important because this helps assess the actual overall health burden on the population and thereby helps develop target-group-specific measures that go beyond mere infection control. It was emphasised that primary prevention of chronic diseases is a key measure for crisis preparedness, in order to strengthen protective and resilience factors within the population.

A key focus of the discussion was that, when addressing the impacts of the pandemic, particular attention must be paid to the situation of vulnerable population groups and to the interplay between societal crises and general health – especially the role of social determinants such as poverty or working and housing conditions. The experts emphasised that the consideration of vulnerable population groups should play a central and guiding role in the analysis of the pandemic's impacts, as whilst crises affect the entire population, they place a particularly heavy burden on disadvantaged population groups. It is paramount to explicitly consider existing increasing and newly emerging vulnerabilities and health inequalities. This also includes consideration of new or different risk factors depending on the specific nature of new crises.

3.2 Impacts of the pandemic and NPIs on NCDs and their risk factors

Mental health and resilience factors

Although the evidence was inconclusive at the start of the pandemic [9], research findings on adults' mental health have repeatedly shown increases in depressive symptoms from autumn 2020 onwards or earlier. Since the second half of 2022, around 20 per cent of the population have met the threshold for elevated depressive symptoms – almost twice as many as in 2019. At the same time, anxiety symptoms also increased, and self-assessed mental health deteriorated [10, 11]. A longer time series spanning 2008 to 2023 also re-

Infobox
COVID-19 Lessons-Learned-Workshop

Background

In order to systematically reflect on the lessons learnt from the COVID-19 pandemic and to optimise future pandemic preparedness, a lessons learnt process took place at the Robert Koch Institute (RKI) from October 2025 to summer 2026.

Objectives

- Scientific evaluation of RKI analyses and recommendations, the resulting activities and their effectiveness, carried out by RKI and interdisciplinary external experts.
- Identification of strengths and weaknesses in the implementation of measures, as well as recommendations for improvements.
- Provision of the results to further develop national pandemic planning in the form of publications.

Method

As part of the process, discussion papers produced internally by the RKI on the activities carried out by the RKI were discussed with 38 external experts. The external experts came from, amongst others, ministries and authorities at federal and state level, universities, public health authorities, laboratories, specialist institutions, associations and hospitals.

Five subject areas were addressed:

1. Diagnostics, testing strategy, surveillance, reporting systems and digital tools
2. Public Health and Social Measures (PHSM) for infection control
3. Medical countermeasures (MCM)
4. Long-term effects (Long COVID) and social determinants
5. International activities

The findings of the individual group discussions in these thematic areas will be disseminated as separate scientific articles in the Journal of Health Monitoring.

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veals a marked change in trend in 2020, with an increase in elevated depressive symptoms, including more severe cases [12]. Negative trends in mental health were observed across all gender, age and educational groups. Women, young adults, people with lower levels of education and low incomes, those living alone, people with a migration background and those with a history of mental health conditions were particularly affected [10–13]. People working in the health sector were also particularly affected [9]. A clear social gradient emerged: depressive symptoms occurred more frequently among people with lower levels of formal education and low incomes, and these inequalities continued to widen from 2022 onwards following the emergence of additional psycho-social and economic pressures, such as the war in Ukraine and rising inflation [13]. By contrast, the prevalence of diagnosed mental disorders in outpatient care provided by physicians and psychotherapists under the statutory health insurance scheme showed comparatively little change overall between 2020 and 2023 [14, 15]. It should be borne in mind, however, that the number of diagnosed mental disorders also depends on whether those affected seek medical or psychotherapeutic help and whether their symptoms are recognised and a diagnosis is made. Trends in the prevalence of recorded diagnoses therefore allow only limited conclusions to be drawn about the prevalence of mental disorders in the general population. However, certain disorders, including depression and anxiety disorders, have been diagnosed with increasing frequency among young adults since 2020 [16].

Findings following the outbreak of the pandemic also indicated high levels of psychological distress and an increase in mental health problems among children and young people [17]. Across Europe, an increase in symptoms of depression and anxiety among children and young people was observed during the first two years of the pandemic; this was particularly pronounced during periods of stricter containment measures and/or school closures [18, 19]. In Germany, the COPSY study showed that the prevalence of mental health problems among children and adolescents had almost doubled from 18 per cent to 31 per cent as early as the first year of the pandemic [20]. The second lockdown (winter 2020/2021) in particular was identified as a critical phase [21]. In outpatient care provided by physicians, diagnoses of depression and anxiety disorders increased markedly from 2021 onwards, particularly among 14- to 17-year-old girls [16]. In the final year of the pandemic, the KIDA study (2022–2023) found that pandemic-related stress played a relatively minor role for children and adolescents compared with stress caused by the war in Ukraine or climate change [22, 23]. By 2024, the mental health of children and young people in Germany had only partially recovered and remained poorer than before the outbreak of the COVID-19 pandemic [20]. Children and young people whose parents had a low level of education, who had a migration background, whose parents were experiencing mental health problems, or who lived in cramped housing conditions, faced an increased risk of psychological and psychosocial stress during the pandemic [21]. Single-parent families were among those under strain during the COVID-19 pandemic. Parents in single-parent households more frequently reported a deterioration in their children's mental health [24]; however, there is as yet no clear evidence for Germany as to whether the psychological strain on single parents themselves increased more sharply than that on parents in two-parent households.

The psychological strain arose both indirectly as a consequence of the NPI (e.g. overwhelming work and caregiving demands, financial pressures, reduced social contacts and access to leisure facilities, restrictions on psychosocial care (see 3.3), increased risk of experiencing domestic violence) and directly from the threat posed by the virus itself (e.g. the potential loss of loved ones, feelings of powerlessness and vulnerability in the context of a global catastrophe) [25]. An international review shows that stricter containment measures and an increased number of COVID-19-related deaths were associated with a deterioration in population mental health [26, 27].

Longitudinal studies by the RKI during the first year of the COVID-19 pandemic showed that relatively stable well-being over time was associated with various factors: adaptive coping strategies (e.g. acceptance, positive reframing), an internal locus of control (i.e. belief in one's ability to influence a situation), perceived social support and a sense of solidarity [28–30]. An international systematic review identified similar key resilience factors during societal crises (including the COVID-19 pandemic), such as high socio-economic status, social support, adaptive coping strategies, emotion regulation skills, a sense of meaning in life, as well as social connectedness and collective efficacy [31]. In children and adolescents, problem-solving skills, family cohesion and social support were found to be protective factors [20].

Digital communication channels and social media could also help maintain social contacts and support during the pandemic-related contact restrictions. However, international reviews point to a mixed picture: digital media could in some cases facilitate social connectedness and support. Exposure to pandemic-related misinformation in particular was also associated with psychological distress [32].

Physical activity and obesity

Physical activity declined during the COVID-19 pandemic, particularly during periods of strict restrictions (including the cancellation of sports activities and the closure of sports facilities and schools) and during the winter months [33]. During these times, opportunities for physical activity were

severely limited and were scarcely compensated for by alternatives. Prerequisites for moving behaviour changed, and established physical activity routines were disrupted. As a result, even people with previously well-established physical activity routines faced barriers that are generally associated with lower levels of physical activity [34]. Even after sports facilities reopened, many did not return to their previous levels of physical activity. This may be due to the fact that the organisational conditions for participating in sport remained compromised, or that individuals' own fitness level had declined during the periods of strict restrictions [35]. Systematic reviews show a decline in moderate to vigorous physical activity among adults [36, 37]. In Germany, the proportion of adults meeting the WHO's physical activity recommendations decreased, particularly amongst middle-aged adults and those with chronic conditions [33]. In the second half of 2021, for example, the GEDA study (n = 2,985) found that 24 % of adults in Germany reported doing less sport since the pandemic began (compared with 12 % who reported doing more sport since then); no significant differences were here based on educational attainment [38]. Physical activity also declined markedly among children and adolescents [39, 40], while sedentary behaviour and screen time increased [41]. Studies using motion sensors found that children and adolescents were, on average, 45 minutes less active per day than before the pandemic [39, 40]. A key factor in the decline in activity was the closure of educational institutions. According to the MoMo study, children and adolescents from socially disadvantaged families were not per se less active during lockdown; however, they reduced their physical and sporting activity particularly if they did not have access to their own garden or lived in large housing estates [42]. Overall, the pandemic exacerbated the already high prevalence of physical inactivity across all age groups.

In Germany, an increase in body weight amongst adults was observed at the start of the COVID-19 pandemic, but this did not continue as the pandemic progressed [43]. Overall, it is not entirely straightforward to determine the impact of the pandemic on the prevalence of obesity, as obesity has been rising steadily for many years, even independently of the COVID-19 pandemic: According to self-reported height and weight data from the RKI's GEDA study, the age-standardised prevalence of obesity was 18 % in 2014/2015, 18.8 % in 2019/2020 and 19.7 % in 2023 [44]. A systematic review concludes that during the first year of the pandemic, a small but potentially clinically significant increase in body weight, body mass index (BMI) and the prevalence of obesity was observed internationally across all age groups [45].

Data from registers of paediatricians in private practice and hospitals show a consistent upward trend in BMI among children and adolescents since 2005. During the pandemic, this rise in obesity prevalence was more pronounced: between 2005 and 2019, the prevalence rose by 0.14 % annually, whereas between 2019 and 2020 it rose by 4.8 %. Furthermore, an increase in the proportion of children demonstrating above-average weight gain was observed during the pandemic [46]. However, it should be noted that a selection bias may be at play here, as parents tended to minimise doctor's visits during the pandemic and therefore healthier children may be under-represented. Among pre-school-aged children, there are marked social differences regarding the rise in obesity: The increase in obesity prevalence among children from families with low parental educational attainment and among children of migrant families is markedly higher than expected based on trend calculations [47]. International data confirm the trend of rising obesity rates among children and adolescents in the early years of the pandemic. However, a decline back to pre-pandemic levels has also been observed as the pandemic has progressed [48]. There is a lack of longitudinal data on whether the children affected remain obese after the pandemic. Analyses of the KiGGS cohort from pre-pandemic times show that two-thirds of children with obesity aged 2–6 years were still obese 10 years later, at the age of 12–17 years [49].

Type 2 diabetes mellitus

In the years prior to 2020, a decline in the incidence of type 2 diabetes had been observed in Germany; however, this trend did not continue during the pandemic years. Two studies observed a marked decrease in incidence in 2020, followed by a return to 2014 and 2015 levels in 2021 and 2022, respectively [50, 51]. Although another study found no difference between the incidence rate during the 2020–2021 pandemic phase and the pre-pandemic phase of 2012–2019, it did identify a weaker decline in incidence between 2018 and 2021 compared with 2012–2017 [52]. The altered incidence pattern during the pandemic might be linked to both direct and indirect consequences of the pandemic, e.g. a possible SARS-CoV-2-related increased risk of developing type 2 diabetes [53, 54], as well as an initial reduction in healthcare utilisation due to infection control measures and consequently a lower rate of diagnosis of new cases, followed by a catch-up effect in terms of healthcare utilisation and diagnosis [55].

Analyses from the RKI's diabetes surveillance project showed that particularly among men with diabetes, the rates of lower-limb amputations above and below the ankle (major and minor amputations) rose between 2021 and 2023. These rates are considerably higher in districts with high socioeconomic deprivation than in less deprived districts [56]. As most diabetes-related major amputations are considered preventable with early, interdisciplinary treatment of diabetic foot syndrome [57], this could indicate that care for people with diabetic foot syndrome could not be maintained at an optimal level during the COVID-19 pandemic. In addition to

continuous monitoring of trends in diabetes-related amputations, targeted care studies are necessary – given the complexity of diabetes care – to understand the impact of the COVID-19 pandemic on care and to develop strategies for preventing diabetes-related amputations in future crises [56].

Cancer

As in many European countries, a marked decline in cancer diagnoses and treatments (particularly in tumour-specific operations carried out as inpatient procedures) was also observed in Germany, especially during the first and second waves of the pandemic [55, 58–61]. By the end of 2022, the number of registered new diagnoses and cancer treatments had returned to levels close to those expected but had not quite reached them. When examining the incidence of individual cancer diagnoses over time, different patterns emerge, suggesting a specific and varying degree of interaction between pandemic-related effects and other influencing factors (particularly adjustments to cancer screening). Since the start of the pandemic, statistically significant deviations from the expected incidence level or trend were observed only for some of the diagnoses examined. Particularly striking is the marked decline in the incidence of colorectal and prostate cancer since the start of the pandemic. No significant increase was observed for any of the cancer diagnoses examined following the start of the pandemic [62]. Restrictions on the availability of medical care, as well as changes in patients' utilisation of healthcare services, may have caused temporary declines in incidence. Long-term declines deviating from the expected trend suggest additional effects [63–66]. For instance, premature COVID-19-associated mortality may have 'prevented' cancer diagnoses, particularly in groups of advanced age or with other risk factors for severe COVID-19 [67]. Up to and including 2024, nationwide cancer registry data have shown no increase of advanced-stage cancer diagnoses compared with the pre-pandemic period (2015–2019). Nor do the cause-of-death statistics show any increase in age-standardised cancer mortality rates during this period [68].

3.3 Impact of the COVID-19 pandemic on the general management of NCDs and their preventive measures

Analyses of data from the GEDA study show a marked decline in the utilisation of outpatient services during the period of containment measures between April and June 2020 [43, 69, 70]. This was followed by a rapid return to pre-pandemic levels [43, 69]. According to data from the Central Research Institute of Ambulatory Health Care in Germany, the utilisation of outpatient medical services did not decline again after October 2020, even as non-pharmaceutical interventions (NPIs) were reintroduced, but remained at a relatively constant level [55]. A more sustained decline can be observed in inpatient care. The number of inpatient cases between 2020 and 2022 was lower than in 2019 (16.8 million versus 19.3 million cases). This was also evident for serious acute conditions such as heart attacks and strokes. In 2023, there was a slight increase to 17.3 million inpatient cases, though this still fell short of pre-pandemic levels [71]. Analyses of statutory health insurance data from the Barmer Ersatzkasse for the years 2019–2024 also revealed persistent changes in the area of inpatient care. The decline in numbers of cases were particularly pronounced among people in need of long-term care who were receiving care at home and had a low care level, suggesting the possibility of similar trends among other vulnerable population groups. The authors conclude that in the wake of the COVID-19 pandemic, concerns about potential health risks associated with hospital stays – such as infections – increased, and that hospital admissions have been systematically avoided [72].

Findings are also available on the provision of care for people with mental disorders [73–75]. The number of inpatient and day-patient treatments in psychiatric, psychosomatic and psychotherapeutic clinics declined markedly during and between lockdown periods. Possible reasons discussed include a reduction in scheduled treatments and the need to provide isolation capacity for those infected with SARS-CoV-2 [75]. In outpatient care, there were fewer new diagnoses of mental disorders and a temporary reduction in the number of psychotherapy cases. Visits to accident and emergency departments due to mental disorders also decreased during the lockdown periods. Whether patients refrained from seeking care due to fear of infection has not yet been investigated. Although there are indications that the restricted provision of care posed a risk of mental health symptoms worsening and becoming chronic, there is a lack of systematic data on the medium- or long-term consequences of these restrictions in care for people with mental disorders [75].

Restrictions on healthcare provision also affected the care of people with cancer. In the early stages of the pandemic, 13 % of cancer patients reported pandemic-related cancellations of appointments, the replacement of face-to-face consultations with telephone or video consultations, and other adjustments, predominantly in the areas of follow-up care and psychosocial or psycho-oncological support. Contact restrictions contributed to the psychological burden experienced by cancer patients. Patients concerned about or experiencing pandemic-related changes to their medical care were particularly affected [64, 65].

The provision and utilisation of telemedicine services increased during the pandemic [76]. In 2017, 4.5 % of statutory health insurance physicians and psychotherapists offered telemedicine services; by 2020/2021, this figure had risen to just under 25 %. Although the proportion of patients with

statutory health insurance who received telemedicine services increased, it remained low on an overall basis (2021: 1.9 %, 2017: 0.2 %). The services were predominantly located in the field of psychotherapy. In 2022 and 2023, there was a decline in the number of video consultations.

The COVID-19 pandemic and the associated protective measures severely restricted opportunities to participate in prevention and health promotion initiatives in 2020/2021. Analyses using data from the COVIMO study in Germany, covering the period from March 2021 to August 2022, showed that primary prevention measures – such as courses, trainings and counselling on nutrition, physical activity, relaxation, sport and fitness – were used significantly less frequently than before the pandemic. Three-quarters of those who generally used these programmes reduced their participation during the pandemic in 2020/2021; socially disadvantaged population groups were hardly reached by these measures as before the pandemic [77]. The uptake of health behaviour-focused individual measures provided by statutory health insurance funds also decreased significantly between 2020 and 2022 (in some cases by more than 50 %) [78].

Medical care for COVID-19 and vaccinations are covered in a separate article from the lessons learned process (The Robert Koch Institute's COVID-19 lessons learned process: vaccination and clinical management).

3.4 Impact of NCDs and their risk factors on SARS-CoV-2 infections and disease

Various studies show that tobacco use increases the likelihood of a severe course of COVID-19 [79]. Furthermore, tobacco use increases the risk of many NCDs, such as chronic obstructive pulmonary disease (COPD), which in turn are considered risk factors for a severe course of COVID-19 [80]. Physical inactivity is also a risk factor for conditions that are thought to be associated with a more severe course of COVID-19 [81], such as obesity, type 2 diabetes and coronary heart disease. A lack of physical activity has been identified as a risk factor for hospitalisation due to COVID-19 [82]. In the context of COVID-19, obesity is considered a risk factor for complications, more severe disease progression, hospitalisation and mortality. This is primarily due to the frequent co-morbidities associated with obesity, such as diabetes mellitus, high blood pressure or lipid metabolism disorders [83–85].

With regard to cardiovascular diseases, particularly people with heart failure were found to have an increased risk of hospitalisation and death [86]. Hypertension was also identified as a significant risk factor for severe COVID-19, whereas only slight increases in risk were observed for coronary heart disease [86–88]. By contrast, the co-existence of chronic respiratory and cardiovascular diseases represented a serious risk factor [86, 89]. Type 2 diabetes also increased the risk of severe COVID-19 and mortality, although the strength of the association varied depending on factors such as adequate blood glucose control [86, 90]. Furthermore, an increased risk of developing Long COVID symptoms has been reported in patients with pre-existing conditions such as asthma, COPD, cardiovascular disease and type 2 diabetes [91–93].

Whether and to what extent cancer contributes to increased COVID-19-associated morbidity and mortality depends, amongst other things, on the type of malignant tumour, the tumour stage and the overall physical condition of those affected (general health, comorbidities) [94–98]. Patients with haematologic malignancies had higher short-term mortality after COVID-19 diagnosis than patients with other types of cancer [94, 95, 97, 99]. The association between lung cancer and COVID-19-related mortality is less clear [98]. Patients with progressive cancers were more likely to experience severe COVID-19 disease [94, 96, 97]. Overall, the evidence is heterogeneous and the findings are, in some cases, contradictory.

People with mental health conditions had an increased risk of COVID-19 infection, severe disease progression and COVID-19-related mortality compared to those without mental health conditions [6, 100–102]. For example, anxiety disorders are associated with an increased risk of developing the disease, and schizophrenia spectrum disorders are associated with increased mortality from COVID-19. Long COVID has also been observed more frequently in people with pre-existing mental health conditions [103]. These increased risks are thought to reflect a combination of biological, behavioural, social and structural factors. Mental health conditions may be associated with comorbidities, risky health behaviours and poor adherence to preventive measures. The use of certain psychotropic drugs is also a potential contributing factor [102]. Furthermore, social disadvantage, stigmatisation and associated barriers can render the prevention and treatment of infectious diseases such as COVID-19 more difficult for people with mental health conditions [104].

3.5 Long-term effects following infection: Long COVID

Long COVID refers to a wide range of physical and mental health complaints and non-specific symptoms that occur over a period of at least four weeks following an acute SARS-CoV-2 infection. The symptoms vary greatly in their clinical presentation and can also affect different organ systems [105]. The most common symptoms include tiredness and pathological exhaustion ('fatigue'), shortness of breath on exertion, sleep disturbances, headaches, and muscle and joint pain [106–108]. Long COVID can severely impair quality of life and ability to work of those affected, lead to prolonged absence

from work, and pose a considerable challenge for relatives and the healthcare system. At the same time, there remain significant gaps in our understanding of the mechanisms underlying the condition. To date, there are no definitive findings regarding the pathophysiology of Long COVID or regarding effective and evidence-based treatment approaches. Patient care is therefore characterised by limited treatment options, a sometimes insufficient level of awareness of existing treatment options in everyday medical practice, and inconsistent and, in some cases, contradictory recommendations. This situation often leads to uncertainty and stress for those affected and their families and makes it difficult to provide care tailored to their needs.

The exact prevalence of Long COVID can only be estimated approximately, as the available data is limited and inconsistent [105]. A study conducted between October 2020 and March 2021 involving adults aged 18 to 65 from southern Germany estimated that at least 6.5 per cent of people who had been infected with SARS-CoV-2 experience Long COVID symptoms within six to twelve months of infection, with impaired everyday functioning as well as reduced work-related performance and functional capacity [109]. However, the incidence of Long COVID shows a downward trend over time, which can be attributed, for example, to increasing immunity within the population as well as to possible differences in the pathogenicity of the virus variants [105]. According to healthcare data, in the second quarter of 2025, a total of 0.28 % of all people covered by statutory health insurance had a diagnosed post-COVID-19 condition according to ICD-10 [110]. However, these results are limited to outpatient billing data and may underestimate the prevalence due to the utilisation patterns of those affected, as well as to medical coding practices.

Systematic reviews indicate that existing Long COVID symptoms subside or disappear completely within a year in the majority of those affected [111–113]. However, in cases involving pre-existing conditions, severe COVID-19 or previous hospitalisation, Long COVID symptoms are reported to persist for a longer period. A systematic review shows that among people who were hospitalised due to COVID-19, 20 per cent still had at least one Long COVID symptom three years after their SARS-CoV-2 infection [114]. Given the high number of SARS-CoV-2 infections and the cumulative increase in cases of prolonged Long COVID, Long COVID is still considered to be of major public health relevance [115–118].

3.6 Social inequality in health chances

The COVID-19 pandemic has made clear that even in the case of a new infectious disease that has the potential to affect everyone, health outcomes are unevenly distributed across the population [119–121]. In Germany, for example, people with low levels of educational qualifications were almost twice as likely to become infected with SARS-CoV-2 as those with high qualifications [122]. A key factor was that people with low levels of vocational qualifications were less likely to have the opportunity to work from home and thereby reduce their social contacts [123, 124]. This was also evident among migrants and their descendants, which was primarily attributable to employment in essential occupations without the option of working from home (e.g. the healthcare sector, cleaning, food processing) as well as overcrowded housing conditions [125–128]. COVID-19 cases, hospital admissions and deaths related to COVID-19 were particularly common among socio-economically disadvantaged people as well as low-status occupational groups [129–134]. During the second wave of the pandemic, socio-economically deprived residential areas recorded a 50–70 % higher COVID-19 mortality rate than affluent residential areas [135]. In addition to increased exposure to the virus and a higher risk of transmission, further risk factors can be identified among socio-economically disadvantaged population groups, such as increased susceptibility to the virus, which is influenced, for example, by pre-existing conditions or the presence of chronic distress. Access to medical care and preventive measures is also more difficult for these population groups [2], and behavioural risk factors for severe COVID-19 outcomes, such as tobacco use, physical inactivity and overweight, are found at above-average rates among socio-economically disadvantaged population groups [136].

Due to the socially unequal distribution of risks of infection and severe courses of COVID-19, health inequalities have, overall, been further exacerbated by the pandemic. This is shown, for example, by the fact that social inequalities in premature mortality and life expectancy were greater during the pandemic than before it [137, 138].

The pandemic and the containment measures also had an impact on key structural determinants of health, such as employment and material circumstances, or educational opportunities. Following a sharp slump in economic output in Germany in the first half of 2020, there was only a slight rise in unemployment; however, the number of people in long-term unemployment increased [139]. Financial losses were generally more common in households with a low household income (under 2,000 euros) than in those with higher household incomes. Groups facing particular financial hardship also included minimum-wage workers in small businesses, who were more frequently affected by short-time working, as well as people in marginal employment who were not entitled to short-time working allowance [140]. Socially unequal impacts were also evident in early childhood and school education: for instance, daycare centres with a high proportion of children from socio-economically disad-

vantaged families were more frequently closed, either fully or partially [141]. Pupils from socio-economically disadvantaged or migrant families were particularly hard hit by the effects of the pandemic and were more likely to report challenging learning situations [142, 143]. Many of these factors were also linked to a deterioration in mental health during the pandemic [144], which went hand in hand with an increase in social inequality [13].

Furthermore, with regard to gender equality, it was observed that during the pandemic women carried the majority of unpaid domestic and family work and were more likely to look after children when daycare centres and schools were closed [145, 146]. There was a global rise in cases of violence against women [147]; in Germany, an increase in calls to the 'Violence against Women' helpline was recorded [148]. Furthermore, many essential occupations were predominantly staffed by women (for example, around 75 % of healthcare workers are women) [149], who were therefore at a higher risk of infection.

4. Conclusions

4.1 General professional recommendations for action from the workshop

For the experts it was a major concern to ensure that the lessons learnt from the COVID-19 pandemic were used to develop a robust framework in which health equity and NCDs are firmly embedded in crisis preparedness and crisis management. Consideration of vulnerable population groups should be integrated as an integral part of any framework for future crises – pandemics and others – so as not to further exacerbate social inequality. When managing a crisis, data-driven, concrete proposals must be drawn up on how vulnerable population groups can be adequately protected, while also considering the unintended consequences of containment measures (e.g. social isolation, psychological stress). The RKI's health monitoring should play a central role here, but to do so it needs to be conducted at more frequent intervals and include population groups not previously considered (e.g. homeless people, refugees, as well as children and young people) in its data collection. Furthermore, the role of NCD prevention as a factor of resilience was emphasised, and it was concluded that prevention needs to be firmly integrated into the structure of future pandemic and crisis strategies. Expertise in the fields of NCDs and social determinants of health should additionally be represented in national bodies from the very outset of a crisis.

The experts also highlighted an urgent need for research into the long-term consequences of infectious diseases and post-viral syndromes.

4.2 Supporting mental and physical health and healthy behaviour as an essential part of pandemic management

The findings underline that in a pandemic, interactions between communicable and non-communicable diseases, as well as between physical and mental health, must be anticipated, and that social circumstances are a key moderator of these interactions. When deciding on containment measures, the potential impacts on NCDs and their risk and protective factors should always be considered. Furthermore, it must be borne in mind that certain population groups (e.g. children, people living in overcrowded housing conditions) are disproportionately affected by the consequences of such NPIs.

Should more extensive NPIs, such as contact restrictions or school closures, become necessary, it is essential from a professional perspective to ensure that support for people with chronic illnesses, those in difficult social circumstances, and children and young people is consistently considered. For example, measures that promote psychosocial health in the general population should be implemented. These include providing adequate and easily-accessible telephone or digital support services [150], implementing social and economic protection measures (e.g. financial subsidies, access to education and care services), providing accessible psychoeducational materials [151], and offering stress management programmes [152] . Accordingly, the WHO also recommends integrating mental health and psychosocial support into all phases of emergency and pandemic planning, from preparedness through to recovery [153].

With regards to promoting physical and mental health as well as general well-being, it would be advisable to maintain physical activity levels among the population, even under pandemic-related restrictions, and to offer suitable alternatives (such as outdoor sports activities, digital formats and everyday conditions that encourage physical activity). This can help prevent weight gain and an increased risk of falls resulting from prolonged periods of reduced physical activity and make it easier to return to previous physical activity routines. Such alternative measures should be aimed at both individuals and settings such as schools, daycare centres, workplaces and care homes.

4.3 Prevention of NCDs – including minimising the risk of disease in the event of a pandemic

The primary prevention of NCDs and the promotion of health-related factors should play an important role in the general population, particularly for people in vulnerable situations – also with regard to future pandemics. As various conditions and lifestyle factors, such as obesity, high blood pressure and tobacco use, have a marked impact on the se-

verity of infectious (respiratory) diseases such as COVID-19, a population with high prevalence rates of NCDs and their risk factors is particularly at risk when infectious diseases spread epidemically. It is therefore sensible, in the interests of 'pandemic preparedness', to invest in health promotion and primary prevention. In Germany, in recent years efforts have so far failed to markedly reduce the prevalence of behaviour-related risk factors and chronic diseases. Furthermore, in many areas social inequalities are tending to increase rather than decrease. Hence, from a professional perspective, there is a need to implement effective preventive policy measures to promote health equity; guidance can be drawn from the World Health Organisation's recommendations for cost-effective interventions (also known as 'quick buys') [154–156]. In the area of tobacco consumption, for example, these include a price increase on tobacco products, plain packaging for cigarettes, and comprehensive bans on advertising and sponsorship. In particular, community-based and structural prevention measures in line with the 'Health in All Policies' approach play an important role [157].

4.4 Ensure the monitoring of impacts on NCDs and their risk factors, as well as post-infection symptoms

Although numerous robust studies demonstrate the impact of the COVID-19 pandemic on NCDs (and vice versa), the findings are heterogeneous, attributable to differences in data sources and methodological approaches. To have access to up-to-date, robust data and comparative figures in the event of a crisis or pandemic, comprehensive public health monitoring is required, including regular time series. This ensures that health trends, as well as the nature and extent of socially determined inequalities, are continuously monitored and analysed. This also allows changes to be reliably identified in the event of a crisis or as a result of preventive policy interventions. In doing so, all population groups – particularly those in vulnerable living situations such as children and young people, the very elderly, migrants and their descendants or those who are socio-economically disadvantaged – should be given equal consideration, and appropriately differentiated monitoring should be made possible. The implementation of the 'Health in Germany' panel [158] and the establishment of an NCD surveillance system at the RKI [159] are important first steps. The RKI panel, as a continuously and flexibly available data source, can, in conjunction with timely analysed routine data, help to systematically build up time series within the framework of the NCD surveillance. In the event of a crisis, structures should be in place to ensure that health indicators particularly sensitive to change are closely monitored [10, 160] and that flexible ad hoc modules can be rapidly integrated into existing panel surveys. In the event of future epidemics and pandemics, post-infection syndromes should also be comprehensively monitored and documented. It is recommended that the monitoring of NCDs in Germany be further expanded to ensure the availability of relevant data for public health interventions and for the evaluation of their effects in the event of another pandemic, during global crises or security threats [161], as well as in non-pandemic periods. This expansion requires adequate staffing and resources.

4.5 Considering and preventing socio-economic inequality during pandemics

Socio-economic inequality is highly relevant in pandemic crisis situations. This has important implications for the management of future pandemics, and may help to improve our understanding of transmission dynamics [134]. Furthermore, interventions should focus on people's living and working conditions. For instance, the possibility of working from home should be explored, particularly for jobs requiring low levels of qualification, while infection control and access to personal protective equipment should be ensured at the workplace. At the same time, low-threshold prevention services need to be expanded and should be developed and implemented in a participatory manner with the public. Examples of this include multilingual health advice involving trusted individuals and key persons from the communities, as well as local, low-threshold testing and mobile vaccination services. It is also important to strengthen trust in institutions, particularly among marginalised population groups, for example through the long-term establishment and expansion of partnerships with relevant stakeholders and self-advocacy groups. In addition to these specific interventions during an epidemic crisis, the long-term and sustainable reduction of health inequalities across the population also represents an important way of rendering a society more resilient to crises. This would require a broadly supported national strategy to improve health equity, which, using a 'Health in All Policies' approach, identifies areas for action across all policy sectors and involves relevant stakeholders. The development of such a comprehensive and long-term action strategy would be professionally advisable [137, 162, 163].

4.6 Limitations

This article is based on a narrative literature review. The focus was on selected diseases and risk factors, as it was not possible within the given scope to provide an exhaustive overview that included, for example, dietary and sleep patterns, chronic lung diseases, or people requiring long term care or with disabilities. The involvement of experts is intended to help avoid potential biases in the selection of topics and studies. A standardised consensus-building process was not carried out.

4.7 Conclusion

This article provides an overview of the impacts of the COVID-19 pandemic on NCDs, including their risk factors, mental health and the long-term consequences of COVID-19, with a particular focus on social determinants. The concept of 'syndemic' helps to explain these complex, intertwined health problems, vulnerabilities and social determinants, and forms the basis for understanding the pandemic as a multidimensional, biopsychosocial phenomenon.

Future epidemics or pandemics (or other health crises of societal relevance) are likely to differ from the COVID-19 pandemic in terms of the pathogen, the spectrum of disease or the containment measures. However, it is very likely that structurally disadvantaged population groups will continue to face a higher risk of adverse health outcomes in future crisis situations or pandemics. These population groups should therefore be given special attention, as they may require specific protective and support measures. To increase the general resilience of the population to health-related crises, greater emphasis should be placed on health equity. This applies to infection control as well as to structural NCD prevention, health-promoting living environments and access to care and support services.

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Declaration of generative artificial intelligence (AI) and AI-assisted technologies
This manuscript was translated, reviewed for language, content and compliance with the journal guidelines using ChatGPT. The authors reviewed and revised the results and take full responsibility for the content of the publication.

Conflicts of interest
The authors declare that there is no conflict of interest.

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