The Lifelines COVID-19 Cohort: a questionnaire-based study to investigate COVID-19 infection and its health and societal impacts in a Dutch population-based cohort

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Abstract

The COVID-19 pandemic has affected billions of people around the world not only through the infection itself but also through its wider impact on public health and daily life. To assess the effects of the pandemic, a team of researchers across a wide range of disciplines developed and implemented the Lifelines COVID-19 questionnaire, leading to the development of the Lifelines COVID-19 cohort. This cohort is recruited from participants of the Lifelines prospective population cohort and the Lifelines NEXT birth cohort, and participants were asked to fill out detailed questionnaires about their physical and mental health and experiences on a weekly basis starting in late March of 2020 and on a bi-weekly basis starting in June 2020. The Lifelines region covers the three Northern provinces of the Netherlands—Drenthe, Groningen and Friesland—which together account for ~10% of the Dutch population. To date, >70,000 people have responded to the questionnaires at least once, and the questionnaire program is still ongoing. Data collected by the questionnaires will be used to address four aspects of the outbreak: (1) how the COVID-19 pandemic developed in the three northern provinces of the Netherlands, (2) which environmental risk factors predict disease susceptibility and severity, (3) which genetic risk factors predict disease susceptibility and severity and (4) what are the psychological and societal impacts of the crisis.

Keywords: COVID-19, population cohort, public health, comorbidities, psychosocial impact, genetics, medication

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**Conflict of interest**

The authors declare no conflict of interest.

**Informed consent**

All Lifelines and Lifelines NEXT participants have provided informed consent that provide the opportunity for add-on research.

**Research involving human participants**

Both the Lifelines and the Lifelines NEXT studies were approved by the ethics committee of the University Medical Center Groningen.
Introduction

COVID-19—the disease caused by infection with the novel coronavirus SARS-CoV-2—has impacted the lives and health of billions of people around the world. Due to the absence of a vaccine, lack of effective antiviral medication and limited understanding of the virus itself, massive efforts have been undertaken by most governments to slow the growth rate of infections through public health measures that have included tracking and testing, shutting down of public life, social distancing policies and stay-at-home orders. These steps have had a huge impact on public well-being, health, the economy (including employment and working conditions) and daily life. The COVID-19 pandemic thus has the potential to exacerbate health and economic inequalities because the concentration of health and labour market disadvantages will be among vulnerable people, such as those with chronic diseases and/or mental health problems. Psychological distress about the pandemic may also have an impact on mental health, as well as social isolation. For youth, the disease risks due to COVID-19 are thought to be small, but the mental health effects of the threat of the pandemic and the associated measures such as school closures may be considerable. The pandemic may also result in unemployment, which could widen socio-economic inequalities in the near future depending how social security systems are able to react and protect. The economic impact will thus further increase the uncertainty and psychological distress experienced by many people.

The effects of the COVID-19 pandemic will therefore be multiple: there will be the impact of the infection itself and the broader societal and health impacts. To identify genetic and environmental risk factors for COVID-19 and address the medical, social and psychological aspects of the pandemic, we developed and implemented a COVID-19 questionnaire, leading to the development of the Lifelines COVID-19 cohort. The questionnaire collects data about COVID-19–related symptoms, current health issues and societal impacts from participants recruited from the Lifelines population cohort [1] and the Lifelines NEXT birth cohort [2], which both monitor the health of the northern Dutch population.
Through a questionnaire that is sent out (bi-)weekly, the project gathers information about the symptoms of COVID-19, associated comorbidities and environmental factors, changes in work and employment, corona-related worries, loneliness and the mental health and societal impacts of the pandemic. In addition, all participating parents are asked about their children’s well-being and Lifelines NEXT parents receive detailed questions about COVID-19-related symptoms expressed by their children. The project has been able to ask questions on a weekly basis since March 30, 2020 that have assessed the evolution of the COVID-19 outbreak and its influence on health in the three northern provinces of the Netherlands.

The Lifelines COVID-19 cohort is a collaboration between researchers from Lifelines; Lifelines NEXT; the University Medical Center Groningen Departments of Epidemiology, Genetics, Nephrology, Psychiatry and Health Sciences; the University of Groningen Faculty of Economics and Business and Faculty of Behavioural and Social Sciences; and the Aletta Jacobs School of Public Health. The data collected by the questionnaires will be used to address four aspects of the outbreak: (1) how the COVID-19 pandemic developed in the three northern provinces of the Netherlands, (2) which environmental risk factors predict disease susceptibility and severity, (3) which genetic risk factors predict disease susceptibility and severity and (4) what are the psychological and societal impacts of the crisis.

COVID-19 in the Netherlands and the Northern provinces

The first three official cases of COVID-19 in the Netherlands were registered on February 27, 2020 [3]. By March 24, 2020, the number of cases diagnosed per day had risen to 1,126, with 750-1400 new cases per day being registered by the Rijksinstituut voor Volksgezondheid en Milieu (RIVM) through April 24, 2020 (Figure 1B). Over this period, the number of deaths officially attributed to COVID-19 rose to ~150 per day. The rapid rise in case numbers in early March led the Dutch government to shut down primary and secondary schools, bars and restaurants, sporting facilities and other public spaces on March 15, 2020,
followed by a more extensive shut-down of public life in the weeks that followed (see Figure 1A for major events). However, the three northern Dutch provinces did not follow the national trends. COVID-19 appeared later in the northern provinces (first reported cases: Drenthe - March 1, 2020, Friesland - March 10, 2020, Groningen - March 11, 2020), ramped up more slowly and never reached the same incidence of cases or infection rates (see Reproductive values in Figure 1C). In the Netherlands, up until June 9, 2020, a total of 47,903 SARS-CoV-2 infections were reported, and the number of COVID-19 hospitalizations and deaths are 11,800 and 6,031, respectively. For the Northern provinces combined, the number of infections, hospitalizations, and deaths over the same period were 1,491 (Drenthe=523, Groningen=352, Friesland=616), 320 (Drenthe=116, Groningen=74, Friesland=130), and 122 (Drenthe=40, Groningen=17, Friesland=65), respectively (see Supplementary table 1). Figure 2 shows the geographical distribution of the number of hospitalizations across all Dutch provinces through mid-May.

Multiple factors have been proposed to explain why the outbreak started later in the Northern provinces, and why its spread was more contained [4][5]. First, Drenthe, Groningen and Friesland together are the least-populated region of the Netherlands, accounting for ~10% of the Dutch population, and contain the fewest urban centres. In addition, the early arrival and spread of infection in the southern Dutch province of North-Brabant seems to have originated in travel to and from Northern Italy during the school holidays from February 22-March 1, 2020, with the spread of the infection in the southern region then further facilitated by personal contact during regional carnival celebrations. In contrast, the school holidays fell earlier for the Northern provinces, from February 15-22, 2020, which suggests that northerners who travelled to Italy during the vacation had returned before the major expansion of the outbreak in Northern Italy [6]. Nor is carnival widely or generally celebrated in the Northern provinces. Other factors may also play a role, e.g. the local testing regime for COVID-19 was stricter, more tests were available in the Northern provinces and healthcare workers had their movements restricted once it became clear that cross-regional travel was a source of new infections [5].
The later arrival of COVID-19 to the North meant that the national steps taken to bring down the infection rate were in place before the outbreak had really taken hold in the region covered by Lifelines, where the caseload has so far remained the lowest in the country (Figure 2). It was against this backdrop that the Lifelines COVID-19 research was developed and implemented.

Methods

Participant pool

Participants of the Lifelines COVID-19 cohort are recruited from the Lifelines population cohort and the Lifelines NEXT birth cohort. Lifelines is a prospective population cohort following ~167,000 people in the three Northern provinces of the Netherlands [1]. The cohort was established in 2006 and collects detailed information about participants via extensive questionnaires and medical examinations. As a population cohort, Lifelines is ideal for investigating common diseases and their relation to lifestyle and environmental factors in a cross-section of the population of the three northern provinces, and the cohort has been shown to be representative of the Northern Dutch population [7]. Lifelines was also designed to recruit multiple participants within families to produce a multi-generational cohort that could map individual and community health across life-course [1]. Since 2016, Lifelines NEXT has been recruiting an additional generation through inclusion of mother-baby pairs, with partners also invited to participate to generate parent-baby trios [2]. In addition, sub-cohorts within Lifelines such as Lifelines DEEP [8] and Lifelines DAG3 have collected much more detailed biological measurements, including genotype, metagenomics, metabolomics and transcriptomics. Lifelines data can also be linked to the administrative records held by Statistics Netherlands (https://www.cbs.nl/en-gb), which include health-related records on mortality, hospital admissions and healthcare costs, as well as data on employment status, income, wealth and other socio-demographic characteristics. This offers a huge potential for
societally relevant research about, for instance, the long-term impacts of the SARS-CoV-2-outbreak on socioeconomic disparities in work and health.

**Recruitment strategy and questionnaire timeline**

To recruit participants for the Lifelines COVID-19 cohort, Lifelines and Lifelines NEXT invited their participants digitally to fill out the questionnaires. All Lifelines participants over the age of 18 for whom an email address is known received a link to the digital COVID-19 questionnaire according to the schedule shown in Figure 1D. The digital invitations were valid for three weeks, and the date on which the questionnaire was completed is registered. All eligible Lifelines participants are invited to participate in each questionnaire round (Q1-Q7 in Figure 1D). Since Lifelines NEXT is an ongoing project in which new participants are still being included, the number of NEXT participants invited increased with each new questionnaire. Invited participants are free to choose if they want to fill in the questionnaire, and the cohort population consists of all those who have filled out at least one questionnaire over the time period of the project.

On March 30, 2020, all Lifelines and Lifelines NEXT participants were invited to participate in the first COVID-19 questionnaire round (Q1), with new invitations to participate sent out weekly following the timeline in Figure 1D. Starting in the week of March 27, 2020, an additional questionnaire about children’s health and symptoms was sent to the participants of the Lifelines NEXT (>300 participants). Questionnaires were sent out weekly through the week of May 18, 2020, and at bi-weekly intervals thereafter. As of writing, the project is set to continue into at least the summer and fall of 2020, which means that recruitment and data gathering are still on-going.

**The Lifelines COVID-19 Questionnaire Contents**
The questionnaire includes modules on socio-demographic parameters, chronic diseases, COVID-19 infection, general health and symptoms, medication use, mental health/well-being of the respondent and of children and young adults in their family, corona-related well-being, social life, social relations and lifestyle (see Table 1 for questions). For participants answering a subsequent version of the questionnaire, these questions are related to their experience in the period since the previous questionnaire, either 7 or 14 days depending on the timing of questionnaires. Data collected by the questionnaires is also linked to data for participants already stored in Lifelines (e.g. height, educational background and many kinds of data from biological samples). Additional questions and question modules have been added as the questionnaire program progressed.

Main questionnaire modules

**Socio-demographics.** Participants are asked about their household location, household make-up (number of co-habitants, number of children), work situation (employment status, employment location including working from home and whether they are still travelling to work, critical worker status and whether they are unemployed due to the crisis), the work situations of their household members, current weight, vaccination status (influenza and BMR) and pregnancy status. Participants who indicate they have children under 18 are asked additional questions about their children’s stress levels and experiences.

**Chronic disease.** Participants are asked whether they have a chronic health condition (cardiovascular disease, lung disease, kidney disease, diabetes, chronic muscle disease, psychiatric disorder, autoimmune disorder, cancer, neurological disease, spleen disease) and have the opportunity to elaborate if their condition is not on the specified list.

**COVID-19.** Participants are asked if they have tested positive for COVID-19 or been diagnosed with COVID-19 by a physician. They are also asked if they themselves think they have had COVID-19, if they
know how they were infected, if any of their cohabitants have tested positive or been diagnosed, and if they have had physical contact with someone with COVID-19.

**Health and symptoms.** Participants are asked to assess their own health and to what extent they have experienced 28 specific symptoms in the preceding week (see Table 1 for full list). They are also asked to assess their experience of fatigue over the same time period.

**Medication use.** Participants are asked whether they have used any of eight classes of commonly used medications (see Table 1 for full list) and to indicate which medications. They can also input other medications not on the list.

**Mental health and well-being.** Participants are asked a series of questions to assess functioning of psychosomatic and mental health. To assess symptoms of depression and anxiety, a subset of the Mini International Neuropsychiatric Interview (MINI) [9] was included in the Lifelines COVID-19 questionnaire. The MINI has been administered in previous assessment waves of Lifelines to assess major depressive disorder (MD) and general anxiety disorder (GAD), which will allow for comparative analyses between pre- and post-outbreak. To evaluate a broader range of psychological problems and symptoms of psychopathology, the 12-item ordinal Symptom CheckList-90 Somatization subscale (SCL-90 SOM), which has been recommended for large-scale studies was surveyed [10]. The 12 items have five Likert-response options. To assess symptoms of fatigue, a subset of the checklist individual strength (CIS-20) [11] was included. Each CIS-20 item had seven Likert-response options. Both the SCL-90 SOM and CIS-20 were also previously implemented in Lifelines. Respondents further received questions on the impact of the pandemic on the mental health of their child or children, if applicable. These regarded three questions on stress of the child because of the Corona-crisis and feeling safe at home and in their community, for children aged 8-12 and 12-18 years.
Corona-related well-being. Participants are asked about their worries about the pandemic, what infection precautions they are taking, where they are getting their COVID-19 information, their perceptions of how the pandemic is affecting society and whether people close to them have had COVID-19 or died of COVID-19. They are also asked to rate their quality of life.

Social life & Connectedness. These two modules ask about feelings of isolation and exclusion and the extent to which participants feel connected to their families, neighbours, communities and nation.

Lifestyle. This module asks participants questions about changes in their eating patterns, exercise and activity levels and tobacco and alcohol use.

Additional modules

COVID-19 and its impact on children. Parents participating in Lifelines NEXT also receive questionnaires related to COVID-19 and symptoms in children. While it is now thought that children rarely develop severe disease, and usually have the asymptomatic form, there are also reports of rare COVID-19 syndromes seen only in children [12]. Using these questionnaires, the project aims to look for the appearance of various symptoms in children. The questions are categorized into three age groups: questions for children aged 0-3 years, questions for children 4-7 years and questions for children 8-18 years old.

Supplemental question modules. Since the start of the Lifelines COVID-19 questionnaire programme, additional modules have been adopted. These include a module for participants 65 and older to examine the impact of the crisis on their daily functioning using the Groningen Frailty index [13] and a module for parents of children aged 8-18 that explores the impact of the crisis on the quality of life of children, measured by the KIDSCREEN-10 [14]. There is also now a questionnaire that examines the impact of COVID-19 on work participation and financial wellbeing, including measures on the quantity and quality
of work performed, work absence, workplace and occupational characteristics. A module using the Positive and Negative Affects Schedule (PANAS) [15] was also recently added to the questionnaire.

Preliminary results

**Response rates and characteristics of respondents.** Based on the availability of an email address and being over 18 years of age, 139,713 out of 159,482 Lifelines participants are invited to respond to the COVID-19 questionnaire during each questionnaire round. Compared to non-invited subjects, these invited subjects were younger, slightly more often female, had a lower BMI and were more often never smokers (Table 2). Of the 139,713 Lifelines participants invited, 68,501 (49%) completed at least one of the questionnaires in the first 6 weeks of the programme. These responders were slightly older, slightly more often female, had a higher BMI and were less often current smokers and more often ex-smokers compared to non-responders (see Table 2). While Lifelines as whole has been shown to be representative of the regional population [7], these slight differences in cohort make up should be considered when looking at data from COVID-19 cohort. However, recruitment is still on-going, and the characteristics of the cohort may change over time.

For Lifelines NEXT, 321 people were invited to participate in the first six weeks of the project, of whom 159 participated (49.5%). Compared to invitees, respondents were more likely to be female (73.5% of respondents versus 50.5% of invitees). As Lifelines NEXT recruits women who are currently pregnant, the age range was small and did not differ substantially between invitees, respondents and non-respondents. In Lifelines NEXT, 80% of all parents who responded to the main Lifelines COVID-19 questionnaire returned data on their children for the module on COVID-19 and its impact on children. In total, we have data for 76 children in week 5 of the COVID-19 questionnaire initiative: 64 children 0-3 years of age, 11 children 4-7 years of age and one child in the 8-18 age group.
COVID-19 infections and the Menni et al. prediction model. Of the participants who responded in the first 6 weeks of the project, 1,034 (1.5%) responded that they had been tested for COVID-19, and 116 (0.2%) tested positive. In addition, 811 (1.2%) respondents said they had been told by a doctor that they probably had COVID-19, while 5,034 (7.3%) participants responded that they thought they had had COVID-19. Menni et al. have developed a model to predict positive COVID-19 cases based on symptoms reported [16], and we applied this model to the data from the questionnaire to predict COVID-19 cases within the cohort. Here we found that of all participants who were not tested for COVID-19, 6.1% were predicted to have had COVID-19. In participants who had been told by a doctor that they probably had COVID-19, 34.5% were predicted to have had COVID-19. In participants who responded that they thought they had had COVID-19, 22.0% were predicted to have had COVID-19. Of the remaining participants, 4.7% were predicted to have had COVID-19. The Menni et al model [16] had an AUC of 0.821 (95% CI: 0.765-0.878) when we applied it to our data using incident positive tests (n=49) and incident negative tests (n=408). The specificity was 0.828 and the negative predictive value was 0.944, indicating that the model is good at predicting the negative cases. However, the sensitivity and positive predictive value were much lower (0.592 and 0.293, respectively) and this indicates that for future applications, for example in genome-wide association studies, the ability of the model to accurately predict the true positive cases needs to be improved, and this work is on-going.

Sharing of early results. Results of the study are continuously updated and shared with Lifelines COVID-19 cohort participants and the Dutch public through the Corona Barometer website (https://coronabarometer.nl/), which presents on-going results as interactive infographics (see snapshot in Figure 2), and through frequent social media posts and press releases. One of the earliest results of the project was a clear signal that feelings of loneliness and isolation were substantially stronger in individuals who lived alone and that this effect was strongest in the youngest age group of respondents (18-30 year olds, see corresponding panel in Figure 2). There was also an increase in the number of
unemployed respondents who reported losing their jobs due to the crisis, rising from 7.5% of unemployed respondents to the first questionnaire round (Q1) up to 14% by the week 5 questionnaire (Q5). More recent results have shown that by the end of May 2020, as the number of infections and hospitalizations dropped to low levels and schools and business reopened, respondents were reporting less anxiety, better sleep and fewer worries about losing their jobs.

**Current and future directions**

The data collected from the Lifelines COVID-19 cohort is currently being analysed to address the four goals of the project. The COVID-19 cases reported by participants are being used to track the outbreak, and the symptoms reported by participants are being examined to generate a symptom-based COVID-19 prediction model, as described above. The data on chronic diseases, medication use and environmental factors (ranging from cohabitation to smoking) will be used to look for associations with SARS-CoV-2 susceptibility and COVID-19 severity, which can help identify risk factors, protective factors and comorbidities. While factors such as age, sex, BMI and certain chronic illnesses have now been associated with a more severe COVID-19 and higher mortality [17], there have also been questions about whether recent BMR vaccinations can be protective factors [18][19], and the data collected in this cohort should help address this question. Important questions about why pregnant women and children seem to be relatively protected will also be analysed. Finally, it will be possible to look at genetic factors in detail as 17,911 of the 68,501 COVID-19 participants who completed at least one questionnaire have been genotyped. Next steps include identifying participants who were also participants in the Lifelines cohorts for which we have more detailed data, e.g. participants with gut microbiome data, currently available for >10,000 Lifelines participants.

Mental health problems are known to increase in times of physical and psychological distress. The current COVID-19 pandemic is accompanied by strict government measures of social distancing and
quarantine to contain and control the spread of the virus. As these events place significant stress on society and increase isolation and loneliness, close monitoring of mental well-being is important for both short- and long-term public health policies and individual-level care. Alertness in clinical systems and tailored mental health care may be needed during and after such a mass traumatic event. The data from the MINI MD and GAD modules and the societal impact modules of the questionnaire will allow researchers to i) longitudinally track the prevalence of symptoms and diagnoses of MD and GAD during the pandemic in the Lifelines and Lifelines NEXT populations, ii) associate symptoms with COVID-19 severity and outcome, iii) identify at-risk groups and individuals and iv) measure the impact of government policies on the overall mental health in the cohort.

The pandemic has had a major impact on the working lives of people in the Netherlands, and the questionnaire will help to address this impact. Healthcare workers are a particularly vulnerable group due to their higher risk of being infected by SARS-CoV-2, and for many workers in healthcare professions, the current working conditions include long work hours, cancelled holidays, working environments with adverse physical and psychosocial work conditions, i.e. high psychological and emotional demands and low control.[20][21]. These working conditions, together with moral distress in relation to the family situation during lockdown, may increase the risk for mental health problems and sickness absence in this occupational group, which is dominated by women, and with a high baseline risk. Other “essential” occupational groups are also experiencing unprecedented changes in their working environments that may affect their physical and mental health as well as their labour market attachment. For many “non-essential” occupational groups that are now encouraged to work from home, the home working environment might not be suitable, as not all jobs can easily be done from home, and many families now have to combine working from home with caring for children. This will likely impact the productivity and quality of their work, as well as the level of stress.
The lockdown has led to a sudden disruption of the economy, and several economic sectors were effectively brought to a standstill. As a result, many workers in these sectors have been temporarily laid-off of work, while workers in other nonessential sectors were encouraged to work from home as much as possible. To protect people from losing their jobs and minimise the impact on self-employed people, the Dutch government implemented a series of financial measures. Despite these measures, however, a large number of workers who were already at a disadvantage because of flexible contracts lost their jobs shortly after the lockdown. The Lifelines COVID-19 questionnaire is monitoring changes in people’s current work situation by asking if they lost their job because of the crisis, if they are working in an essential job, and whether they have to work from home. The answers to these questions will be used to monitor both the impact of the crisis on the short- and longer-term labour market and to identify workers most at risk of losing their job. This is essential information for policymakers to be able to target measures to the most vulnerable groups in society and mitigate the financial impact of the crisis.

**Links to other national and international programs**

All the data generated by the Lifelines COVID-19 questionnaire is linked to data held in Lifelines about its participants. This will allow for longer-term monitoring of participants beyond the timeline of the questionnaire program and the COVID-19 outbreak. Besides linkage to other Lifelines data, the Lifelines COVID-19 cohort data can also be linked to societal data held by Statistics Nederland, to drug prescription data held by IADB.nl via the Pharmlines initiative [22] and to SARS-CoV-2 testing data (including serological data) held by Certe and other Dutch laboratories. Overlap with enriched Lifelines datasets in Lifelines Deep [8], Lifelines DAG3 (an on-going project with metagenomic sequencing the gut microbiome of 10,000 Lifelines participants) and Lifelines NEXT [2] will also allow for research projects with a different scope. Given that there is now genetic data for 17,911 of the 68,501 COVID-19 cohort participants generated through the UMCG Genetics Lifelines Initiative (UGLI), it will be possible to look at
genetic risk (and protective) factors. The Lifelines COVID-19 project is also participating in the COVID-19 Host Genetics Initiative [23], an international collaboration to share and analyse data to identify the genetic determinants of SARS-CoV-2 susceptibility, COVID-19 severity and outcomes.

The Lifelines COVID-19 questionnaire was designed to make comparisons with similar projects throughout Europe. Direct cross-national comparisons with projects in Denmark and France are possible, as they are using nearly identical questionnaires, and will provide unique opportunities to examine the effect of different governmental measures on mental health and well-being. This cohort is also part of COVID-MINDS, an initiative at UCL. These insights can be used to fine-tune some of the measures when there will be a second wave of the COVID-19 epidemic. Moreover, the Lifelines COVID-19 questionnaires have been requested by other (inter)national researchers as basis for designing their own questionnaires, i.e. separate research has been done on the experiences of COVID-19 patients, both hospitalised and not hospitalised, making use of the Lifelines COVID-19 questions.

**Strengths and limitations**

One of the main strengths of this project is its embedding within the now long-running Lifelines prospective population cohort, which provides a rich data background about participants and the knowledge, infrastructure and relationship with participants necessary to recruit and engage participants during an evolving crisis. The high and sustained rate of response and the weekly questionnaires mean that the project will have a detailed longitudinal prospective view of both the outbreak and the wider psychological and societal impacts of the crisis. Another strength is the collaboration of researchers across a range of disciplines in designing and implementing the questionnaire, which means that the questions included can be used to address a wide range of research questions, can have immediate impact on policy and can be used to help design new policies to prevent and/or manage renewed
outbreaks. Finally, Lifelines will continue to follow its participants for the coming decade and beyond, providing opportunities to examine the long-term health impacts of the pandemic.

The timing and nature of the COVID-19 outbreak in the Northern Netherlands, which diverged from that in other parts of the country, is both a strength and a limitation. The relatively low number of cases in the region, even accounting for undiagnosed cases, may seem to pose difficulties for statistical association analyses looking at COVID-19-related factors. However, even within our cohort, >800 participants have had a COVID-19 diagnosis, confirmed either through a positive test or through a doctor’s diagnosis, which permits a wide number of statistical association analyses. Moreover, the impact of the societal steps taken to reduce the rate of infection in more heavily impacted regions of the Netherlands and the impact of the associated economic crises should have similar psychological and social impacts in the Lifelines population. The fact that the outbreak in the North was effectively capped by public health steps now puts the questionnaire programme in an interesting position to monitor the immediate health and societal impacts of the lockdown measures and the subsequent impact of coming out of lockdown. It may also lay groundwork for steps to be taken if there is a later resurgence of COVID-19 infections, and the data generated while infection rates were low could work as baseline values if subsequent outbreaks in the Northern provinces are more intense.

**Collaboration**

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Figures

**Figure 1. Timeline of the COVID-19 pandemic in the Netherlands and Lifelines data collection.** 1A. Important events of the pandemic in the Netherlands from February to June 2020. 1B. Daily reported positive infections (grey) and hospitalizations (blue) visualized alongside the change in mobility (black) in the Netherlands. Mobility is quantified using Apple Maps Request data ([https://www.apple.com/covid19/mobility](https://www.apple.com/covid19/mobility)) with the change over time normalized to February 1, 2020. Change in mobility indicates the percentage change in overall requested driving directions by users of Apple Maps. COVID-19 daily infections and hospitalizations are derived from the CoronaWatchNL github account ([https://github.com/J535D165/CoronaWatchNL](https://github.com/J535D165/CoronaWatchNL)) and are based on reported numbers from the RIVM. 1C. The reproductive number in the Netherlands and the three Northern provinces over time. The R(t) is calculated based on incident cases (new positive PCR tests) including healthcare workers and cases appertaining to local outbreaks. National and regional R(t) values in the early phase of the pandemic are not directly comparable, since testing among healthcare workers was more widely adopted early on in the Northern provinces. 1D. Overview of the Lifelines COVID-19 data collections. The pie chart on the left shows the proportion of participants for each province. The first weekly COVID-19 questionnaire (Q1) was sent out on March 30, 2020. Based on Q1-7, 71,800 unique respondents have filled out at least one questionnaire. From Q7, assessments are biweekly.
Figure 2. Distribution of hospitalization across Dutch municipalities. The number of hospitalizations per municipality, as reported by the RIVM, were integrated with a geographical map of the Netherlands. For each municipality, the cumulative number of COVID-19 hospitalizations per 100,000 residents is shown. The Lifelines region is outlined in grey. This data was downloaded on May 18, 2020.
Figure 3. Communicating COVID-19 cohort results to the public through the Coronabarometer.

Snapshot of the Coronabarometer ([https://coronabarometer.nl/](https://coronabarometer.nl/), in Dutch), which is updated after every questionnaire round to present the most recent findings of the Lifelines COVID-19 questionnaire in a format accessible by the public. The website is now interactive to enable users to look at trends over time and compare variables.
# Tables
Table 1. Lifelines COVID-19 questionnaire. Questions asked are modified slightly when respondents have filled in a previous questionnaire to indicate that they should answer with respect to the intervening period.

| Subject         | Question                                                                 | Answer type                                                                 |
|-----------------|---------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| SOCIO-DEMOGRAPHIC |                                                                           |                                                                             |
| Age             | 1. What are the four numbers of the postcode of your home address?        | Numerical field                                                             |
| Sex             | 2. What are the four numbers of the postcode of your home address?        | In the Lifelines database                                                    |
| Location        | 3. What are the four numbers of the postcode of your home address?        | Numerical field                                                             |
| Living situation| 4. The following questions are about your household members who live with you at least one day a week. |                                                                             |
|                 | 4a1. How many household members are between 0-12 years of age?            | Numerical field                                                             |
|                 | 4a2. How many household members are between 13-18 years of age?           | Numerical field                                                             |
|                 | 4a3. How many household members are between 18-30 years of age?           | Numerical field                                                             |
|                 | 4a3a. How many household members are between 19-30 years of age?          | Numerical field                                                             |
|                 | 4a4. How many household members are between 30-59 years of age?           | Numerical field                                                             |
|                 | 4a4a. How many household members are between 31-60 years of age?          | Numerical field                                                             |
|                 | 4a5. How many household members are older than 60 years of age?           | Numerical field                                                             |
| Effects Children| If 4a1 > 0 or 4a2 > 0                                                    |                                                                             |
|                 | 4b. Are your household members under 19 years of age your children or foster children? | Yes/ No/ Both                                                              |
|                 | If 4b = ‘Yes’ or ‘Both’                                                  |                                                                             |
|                 | 4b1. Are your children (or child) experiencing stress about the corona crisis? | No stress / some stress / much stress / a lot of stress                      |
|                 | If 4b1 = ‘some stress’ or ‘much stress’ or ‘a lot of stress’              |                                                                             |
|                 | 4b1a. How do they show that?                                             | Text field                                                                  |
|                 | If 4b = ‘Yes’                                                            |                                                                             |
|                 | 4b2. Do your children (or child) feel safe at home?                       | Safe / somewhat safe / unsafe / very unsafe                                 |
|                 | 4b3. Do your children (or child) feel safe in their neighbourhood?        | Safe / somewhat safe / unsafe / very unsafe                                 |
| Employment      | 5. What is your current work situation?                                  | I am a student / I work (full-time, part-time, freelance) / I am disabled / I am unemployed / I am retired |
|                 | If 5 = ‘I work’                                                          |                                                                             |
|                 | 5a. What kind of work contract do you have?                              | Full-time / Part-time / zero hour, flexible, on call / freelance            |
|                 | 5b. What is your current work situation?                                 | I am working from home / I am being paid to work from home / I have been laid off work without pay / I continue to work at the usual location (e.g. office, factory, construction site) / I continue to work at multiple sites for my job / I have been forced to take sick leave or vacation time |
|                 | If 5b = ‘I continue to work at the usual location’                       |                                                                             |
|                 | 5c. Do you have a critical job? (As defined by the government)            | Yes/No                                                                      |
5d. What is the location of your workplace? (postcode)  

| Question                                                                 | Answer Type |
|--------------------------------------------------------------------------|-------------|
| if $5 = 'I am unemployed'$                                                |             |
| 5e. Are you unemployed because of the Covid-19 crisis?                   | Yes/No      |
| if $5 = 'I work'$                                                       |             |
| 5f. Since the start of the Corona crisis in NL (mid-March), have you sometimes or regularly worked night shifts? | Yes, regularly / Yes, sometimes / No |
| 5g. Do you work in a profession in which you still come into frequent contact with patients, clients, children or the general public since the start of the corona crisis in the Netherlands (mid-March)? (For example, nursing, teaching, supermarket staff, police, emergency services etc.) | Yes/No |

4.1 Do you have any other household members? This applies to anyone who lives with you at least one day a week.  

| Question                                                                 | Answer Type |
|--------------------------------------------------------------------------|-------------|
| if $4a1$ or $4a2$ or $4a3$ or $4a4$ or $4a5 > 0$                           |             |
| 4c. Do any of your household members have a critical job? (As defined by the government.) | Yes/No      |
| 4d. Does at least one of your household members work outside the house?  | Yes/No      |

Weight  

| Question                                                                 | Answer Type |
|--------------------------------------------------------------------------|-------------|
| 8a. What is your current weight (in kg)? If you have scale in the house, please weigh yourself. | Numerical field, kg |
| 8b. At what time of day did you weigh yourself?                           |             |
| Vaccinations                                                             |             |
| 9. Did you get a flu shot in the past year?                               | Yes/No/Don't know |
| 10. Have you ever been vaccinated against tuberculosis? (BCG)             | Yes/No/Don't know |
| if $11='Yes'$                                                            |             |
| 10a. What year were you vaccinated against tuberculosis (give an estimate if not sure)? | Numerical field |

**CHRONIC ILLNESSES**

| Subject | Question                                                                 | Answer Type |
|---------|--------------------------------------------------------------------------|-------------|
| Illness | 1. Do you have a chronic health condition?                               | Yes/No      |
|         | 1a. Cardiovascular disease (including high blood pressure)               |             |
|         | 1a1. High blood pressure                                                |             |
|         | 1a1. Heart attack                                                       |             |
|         | 1a1. Narrowing of the arteries in the legs                              |             |
|         | 1a1. Stroke or TIA                                                      |             |
|         | 1a1. Other heart and/or coronary disease                                |             |
|         | 1b. Lung disease, such as asthma, COPD or chronic bronchitis            |             |
|         | 1c. Liver disease                                                       |             |
|         | 1d. Kidney disease or reduced kidney function                           |             |
|         | 1e. Diabetes                                                            |             |
|         | 1f. Chronic muscle disease                                              |             |
|         | 1g. Psychological illness, such as depression, psychosis or anxiety disorder |             |
1h. Auto-immune illness, such as celiac disease, inflammatory bowel disorder, rheumatoid arthritis, lupus  
1i. Cancer  
1j. Neurological disease, such as dementia, Parkinson's disease or Alzheimer's disease  
1k. Problems with your spleen (e.g. sickle cell anaemia, spleen removed)  

1m. Do you have another kind of chronic condition?  
1m1. Specify other condition

### COVID-19 RELATED

| Subject | Question                                                                 | Answer type                                                                 |
|---------|--------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| COVID-19| The following questions are about the period since the outbreak of the new corona virus. |                                                                           |
| 1a.     | Have you been tested for coronavirus (COVID-19)?                         | Yes/No                                                                      |
| if 1a = 'Yes' |                                                                  |                                                                             |
| 1a1.    | Do you have or have you had a coronavirus/COVID-19 infection?            | Yes/No                                                                      |
| 1a1.    | What was the result of your corona virus (COVID-19) test?               | Positive, I have a corona virus infection (COVID-19)/Negative, I do not have a corona virus infection (COVID-19) |
| if 1a = 'No' |                                                          |                                                                             |
| 1b.     | Has a doctor told you that you may have (or have had) a Covid-19 infection? | Yes/No                                                                      |
| 1c.     | Do you also think you have (or had) a Covid-19 infection?               | Yes/No                                                                      |
| if 1a1='Yes' or 1b='Yes' or 1c='Yes' |                                                                 |                                                                             |
| 1d.     | Do you know how you got the infection?                                   | Household family member / other family member / friends                      |
|         |                                                                          | / coworkers / sport / other / unknown                                        |
| 2a.     | Has someone you live with tested positive for a Covid-19 infection?      | Yes/No                                                                      |
| 2b.     | Has someone you live with been told by a doctor that they might have Covid-19? | Yes/No                                                                      |
| 2c.     | Have you had contact with someone who tested positive for Covid-19? This means physical contact rather than by, e.g., telephone. | Yes/Not that I am aware of                                                  |
| 2d. In the last 14 days | have you had contact with someone who tested positive for Covid-19? This means physical contact rather than by, e.g., telephone. | Yes/Yes, but I am a healthcare professional and used the appropriate personal protection equipment/Not that I am aware of |
| 2e. Before filling in the previous questionnaire, had you had contact with someone who has been diagnosed COVID-19 in the interval between then and now? This person either had symptoms at the time of contact or in the previous 24 hours, or they were diagnosed within a week after contact. | Yes/Yes, but I am a healthcare professional and used the appropriate personal protection equipment/Not that I am aware of |

### Hospitalization

| Subject      | Question                                                                 | Answer type                                                                 |
|--------------|--------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| if 1a1='Yes' or 1b='Yes' |                                                                  |                                                                             |
| 3.           | Have you been hospitalized for a Covid-19 infection?                     | Yes/No                                                                      |

Have you been hospitalized for a Covid-19 infection since the last time you filled in the corona virus (COVID-19) questionnaire?  
if 3 = 'Yes' |                                                                             |
| 3a.         | Were you given supplemental oxygen?                                      | Yes/No                                                                      |
| 3b.         | Were you put on antibiotics?                                             | Yes/No                                                                      |
| Subject            | Question                                                                 | Answer type                                                                 |
|--------------------|--------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| Overall health     | 1. How would you rate your health, in general?                           | excellent / very good / good / medium / poor                                 |
| Recent symptoms    | 2. To what degree have you experienced the following symptoms in the last 7 days: (Please fill in these answers even if the symptoms are chronic for you or you think you had them for reasons other than a corona virus infection) | not at all / a little / some / quite a lot / often                           |
|                    | 2a. Headache                                                             |                                                                             |
|                    | 2b. Dizziness                                                            |                                                                             |
|                    | 2c. Heart or chest pain                                                 |                                                                             |
|                    | 2d. Lower back pain                                                     |                                                                             |
|                    | 2e. Nausea or upset stomach                                             |                                                                             |
|                    | 2f. Muscle pain/aches                                                   |                                                                             |
|                    | 2g. Difficulty breathing                                                |                                                                             |
|                    | 2h. Feeling suddenly warm, then suddenly cold again                     |                                                                             |
|                    | 2i. Numbness or tingling somewhere in your body                          |                                                                             |
|                    | 2j. A lump in your throat                                               |                                                                             |
|                    | 2k. Part of your body feeling limp                                      |                                                                             |
|                    | 2l. A feeling of heaviness in your arms or legs                         |                                                                             |
|                    | 2m. Shortness of breath                                                 |                                                                             |
|                    | 2n. Pain when breathing                                                 |                                                                             |
|                    | 2o. Runny nose                                                          |                                                                             |
|                    | 2p. Sore throat                                                         |                                                                             |
|                    | 2q. Dry cough                                                           |                                                                             |
|                    | 2r. Wet cough                                                           |                                                                             |
|                    | 2s. Fever (38 degrees or higher)                                        |                                                                             |
|                    | 2t. Diarrhoea or stomach pain                                           |                                                                             |
|                    | 2t1. Diarrhoea                                                          |                                                                             |
|                    | 2t2. Stomach pain                                                       |                                                                             |
|                    | 2u. Loss of sense of smell or taste                                     |                                                                             |
|                    | 2v. Red, painful or itchy eyes                                          |                                                                             |
|                    | 2w. Sneezing                                                            |                                                                             |
|                    | 2x. Sensitive skin                                                      |                                                                             |
|                    | 2y. Pain in neck, shoulder(s) or arm(s)                                 |                                                                             |
|                    | 2z. Upper back pain                                                     |                                                                             |
| Fatigue            | 3. To what degree do you experience the following in the last 7 days:    |                                                                             |
|                    | 3a. I felt tired                                                         |                                                                             |
3b. I got tired quickly
3c. I felt fine
3d. I felt physically exhausted

7 point NRS with left anchor “Yes, that's correct” and right anchor “No, that's not correct”

Sex
4. Are you a woman between 18 and 55 years of age? We do have this information in our database, but to ensure the rapid processing of this questionnaire, we are asking you to fill this in again.

| If 4 = Yes |
| --- | --- |
| Menstruation | 4a. Did you menstruate in the last 7 days? |
| Yes / No / Prefer not to say |

Doctor avoidance
5. In the last 7 days have you had health problems that you would normally see the doctor for, but chose not to contact your doctor?

6. What best describes these symptoms?

7. Why did you choose not to contact your doctor? More than one answer is possible.

MEDICATION

| Subject | Question | Answer type |
| --- | --- | --- |
| 10. Has your medication usage changed since the last time you filled in the corona questionnaire? Don't forget to think about over-the-counter medications like cough syrup or paracetamol. If you're not sure, click 'Yes'. | Yes/No |

If 10 = Yes

Have you taken any medications in the last 7 days?

Which medications have you taken in the last 7 days?

1. High blood pressure medicine (such as metoprolol, furosemide, enalapril) Yes/No
2. Inhaler Yes/No
3. Corticosteroids in tablet form (such as prednisone) Yes/No
4. Other corticosteroids (such as injections, hormone creams, eye or ear drops) Yes/No
5. Cholesterol lowering medication Yes/No
6. Diabetes medication Yes/No
7. Cough medicine Yes/No
8. Pain medication Yes/No
9. Other Text

If 1 = ‘Yes’

Which blood pressuring lowering medications (e.g. metoprolol, furosemide, enalapril) have you used in the last 7 days? Multiple answers are possible.

- Hydrochlorothiazide
- Furosemide (e.g. Lasix®)
- Bumetanide (e.g. Burinex®)
- Atenolol
- Metoprolol (e.g. Selokeen ZOC®)
- Bisoprolol (e.g. Emcor®)
- Captopril
- Enalapril (e.g. Renitec®)
- Lisinopril (e.g. Zestril®)
- Nifedipine
| If 2 = ‘Yes’ | **Which inhalers have you used in the last 7 days?** Multiple answers are possible. |
| --- | --- |
| Text | Salbutamol (e.g. Ventolin®, Airomir®), Formoterol (e.g. Oxis®, Foradil®), Salmeterol (e.g. Serevent®), Ipratropium (e.g. Ipraxa®, Atrovent®), Tiotropium (e.g. Spiriva®), Beclometasone (e.g. Qvar®), Budesonide (e.g. Pulmicort®), Fluticasone (e.g. Flixotide®, Foster®, Symbicort®, Seretide®) |

| If 3 = ‘Yes’ | **Which corticosteroids (such as prednisone) have you used in the last 7 days?** Multiple answers are possible. |
| --- | --- |
| Text | Cortisone, Dexamethasone, Hydrocortisone, Prednisolone, Prednisone |

| If 4 = ‘Yes’ | **Which other corticosteroids (such injections, hormone creams or eye/eardrops) have you used in the last 7 days?** Multiple answers are possible. |
| --- | --- |
| Text | Injection with triamcinoloneacetonide (e.g. Kenacort-A®), Salve or cream with triamcinoloneacetonide, Neusspray met triamcinoloneacetonide (e.g. Nasacort®), Eardrops with triamcinoloneacetonide, Salve or cream with hydrocortisone, Salve or cream fluticasone (e.g. Cultivate®), Salve or cream with betamethasone, Salve or cream with dexamethasone, Eyedrops with dexamethasone, TriAnal® |

| If 5 = ‘Yes’ | **Which cholesterol lowering medications have you used in the last 7 days?** Multiple answers are possible. |
| --- | --- |
| Text | Simvastatin (e.g. Zocor®), Atorvastatin (e.g. Lipitor®), Fluvastatin (e.g. Lescol®), Rosuvastatin (e.g. Crestor®), Pravastatin, Gemfibrozil (e.g. Lopid®), Cholestyramine (e.g. Questran®), Ezetimib (e.g. Ezetrol®, Inegy®) |

| If 6 = ‘Yes’ | **Which diabetes-related medications have you used in the last 7 days?** Multiple answers are possible. |
| --- | --- |
| Text | Insulin (e.g. Novorapid®, Novomix®, Insulatard®, Mixtard®, Lantus®), Metformin, Tolbutamide, Gilbenclamide, Gliclazide (e.g. Diamicron®), Pioglitazone (e.g. Actos®), Repaglinide (e.g. NovoNorm®), Acarbose (e.g. Glucobay®), Sitagliptine (e.g. Yesnuvia®) |

| If 7 = ‘Yes’ | **Other, specifically medicine 1:** Text |
| --- | --- |
| Text | **Other, specifically medicine 2:** Text |
### MENTAL HEALTH AND WELL-BEING

| Subject | Question                                                                 | Answer type |
|---------|--------------------------------------------------------------------------|-------------|
| MINI - Depression | 1. In the last 7 days have you felt low or depressed for much of the day, every day? | Yes/No |
| MINI - Depression | 2. In the last 7 days have you had the feeling that you've lost interest in or the will to do things you are normally interested in? | Yes/No |
| MINI - Depression | 3. The following questions are about your experience in the last 7 days:     |             |
| MINI - Depression | 3a. Did your appetite change noticeably, or did your weight increase or decrease without this being intended? | Yes/No |
| MINI - Depression | 3b. Have you had problems sleeping almost every night (difficulty falling asleep, waking up in the night or too early in the morning, or actually sleeping too much)? | Yes/No |
| MINI - Depression | 3c. Did you speak or move more slowly than normal? Or did you feel restless, jittery and could barely sit still? Nearly every day? | Yes/No |
| MINI - Depression | 3d. Did you feel worthless or guilty almost every day? | Yes/No |
| MINI - Depression | 3e. Was it difficult to concentrate or make decisions almost every day? | Yes/No |
| MINI - Depression | 3f. Have you considered hurting yourself, wished you were dead, or had suicidal thoughts? | Yes/No |
| MINI - Anxiety | 4. In the last 7 days, have you been worrying excessively and worrying about multiple problems of everyday life, at work, at home, in your immediate environment? | Yes/No |
| MINI - Anxiety | 4a. Were these worries present almost every day in the last 7 days? | Yes/No |
| MINI - Anxiety | 4b. In the last 7 days did you find it hard to set these worries aside or did they prevent you from concentrating? | Yes/No |
| MINI - Anxiety | 5. In the last 7 days did it often happen that... |             |
| MINI - Anxiety | 5a. You felt restless, jittery or nervous? | Yes/No |
| MINI - Anxiety | 5b. You felt tense? | Yes/No |
| MINI - Anxiety | 5c. You were particularly irritable? | Yes/No |

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### CORONA RELATED WELL-BEING

| Which cough medicines have you used in the last 7 days? Multiple answers are possible. | Codeine, Noscapine, Broomhexine, Althea syrup of thyme syrup, Dextromethorphan, Pentoxyverine, Acetylcysteine, Carbocysteine, Promethazine, Chamomile or menthol |
| Other, specifically medicine 1: | Text |
| Other, specifically medicine 2: | Text |
| If 8 = ‘Yes’ Which pain killers have you used in the last 7 days? Multiple answers are possible. | Paracetamol (acetaminophen), Ibuprofen (e.g. Brufen®), Acetylsalicylic acid (e.g. Aspirin®), Diclofenac (e.g. Aleve®), Codeine, Tramadol (e.g. Tramal®), Oxycodone (e.g. OxyContin®, OxyNorm®, Morphine (e.g. MS Contin®, Oramorph®) |
| Other, specifically medicine 1: | Text |
| Other, specifically medicine 2: | Text |
| If 9 = ‘Yes’ 9a. How many other different medicines have you used in the last 7 days? (maximum 10) | Text |
| Subject                  | Question                                                                 | Answer type                                      |
|--------------------------|---------------------------------------------------------------------------|--------------------------------------------------|
| Pandemic worries         | 1. How much have you been concerned about the corona crisis in the past 7 days? | 1=not concerned, 10=extremely concerned          |
|                          | 2a. I worry about getting sick myself                                      | Never / almost never / sometimes / frequently / always or almost always |
|                          | 2b. I worry that someone close to me will get sick                        |                                                   |
|                          | 2c. I am concerned that I or my family will be in serious financial trouble |                                                   |
|                          | 2d. I worry that I will lose my job                                       |                                                   |
|                          | 2e. I worry that it will be a long time before my life returns to normal   |                                                   |
|                          | 2f. I am concerned that I can't see friends and family                    |                                                   |
|                          | 2g. I am worried for another reason                                       |                                                   |
|                          | if 2g = 'sometimes/frequently/always or almost always'                    |                                                   |
|                          | 2g. For what other reason are you worried?                                |                                                   |
| Infection precautions   | 3. What precautions are you taking to prevent the spread of the coronavirus? | Frequent hand washing / Use of hand disinfectant / Social distancing (except for household members) / Social distancing, including household members / Covering my mouth and nose in public / Avoiding public transport / Reduced travel / Other, specifically... |
| Information sources      | 4. Where have you been getting your information and advice from in the last 7 days? | Media (Newspaper, TV, radio) / Health authorities (e.g. government, RIVM, WHO) / Social media (e.g. Facebook, twitter, Instagram) / Family and friends / Others |
| Perceptions              | 5. Covid-19 threatens everyone in the Netherlands.                        |                                                   |
|                          | 6. Since the beginning of the Covid-19 crisis, I see others in my area, such as people in the neighbourhood or in shops, as a threat to my well-being. | 1=totally disagree, 2=disagree slightly, 3=neutral, 4=agree slightly, 5=totally agree |
|                          | 7. I have faith in the Dutch government's response to the corona crisis.      |                                                   |
| Corona proximity         | 8. Does someone close to you have a Covid-19 infection?                    | Yes/No                                           |
|                          | 9. Has someone close to you died of a Covid-19 infection?                  | Yes/No                                           |
| Quality of life          | 10. How would you rate your quality of life over the last 7 days?           | 1= terrible, 10=excellent                        |
| SOCIAL LIFE              |                                                                           |                                                   |
| Subject                  | Question                                                                 | Answer types                                     |
| Social isolation         | 1. How socially isolated have you felt in the last 7 days?                 | 1=not socially isolated, 10=extremely socially isolated |
| Loneliness               | 2. Can you tell us about how you felt in the last 7 days?                  | Almost never or never / sometimes / often         |
|                          | 2a. How often do you feel excluded?                                       |                                                   |
|                          | 2b. How often do you feel isolated from others?                           | Almost never or never / sometimes / often         |
2c. How often do you feel alone? Almost never or never/ sometimes/ often

| SOCIAL RELATIONS |  |
|------------------|------------------|
| Subject | Question | Answer type |
| Can you indicate how much you agreed with the statements below in the last 7 days? | | |
| 1. I feel connected to all Dutch people | 1=totally disagree, 2=disagree slightly, 3=neutral, 4=agree slightly, 5= totalmente agree |
| 2. I feel connected to my neighbours, family and/or friends |  |
| 3. I get the help and support I need from my neighbours, family and/or friends |  |
| 4. I do everything I can to help others who are infected with Covid-19 |  |
| 5. I expect that others will do everything they can to help me if I get infected or ill with Covid-19 |  |
| 6. I do not feel obliged to comply with the government’s corona measures |  |
| 7. I feel excluded by society |  |
| 8. I feel that I am not appreciated by others in society |  |
| 9. I am frustrated with how things are now going in society |  |
| 10. I am afraid that things will go wrong in our society |  |

| LIFESTYLE CHANGES |  |
|-------------------|------------------|
| Subject | Question | Answer types |
| Eating patterns | 1. How healthy are you eating compared to the period before the Covid-19 crisis? | 1=Much less healthy, 2=less healthy, 3=just as healthy, 4=healthier, 5=much healthier |
| | 2. How often do you eat per day? | 1=Less than 3x per day, 2=3x per day, 3=4x per day, 4=5x per day, 5=6x per day, 6=7x per day, 7=8x per day, 8=more than 8x per day |
| | 3. How important do you think healthy eating is compared to the period before the Covid-19 crisis? | 1=Much less important, 2=Less important, 3=Just as important, 4=More important, 5=Very important |
| Exercise | 4. Before the corona crisis, how many minutes of (relatively) intense activity did you do each week (e.g. walking, biking or running)? | 1=Less than 50 mins, 2=50-100 mins, 3=100-150 mins, 4=150-180 mins, 5=more than 180 minutes |
| | 5. In the last 7 days, how many minutes of (relatively) intense activity did you do (e.g. walking, biking or running)? | 1=More than in the period before the Covid-19 crisis, 2=Just as much as in the period before the Covid-19 crisis, 3=Less than in the period before the Covid-19 crisis |
| | 6. I do muscle and bone strengthening exercises, such as Nordic walking, jumping rope or weight training: | |
| Smoking | 7. Have you smoked in the last 7 days? | Yes/No |
| Alcohol | 8. Have you drunk alcohol in the last 7 days? If yes, how many units, on average? | 0=0, 1=1 glass or ‘once’, 2=2 glasses, 3=3 glasses, 4=4 glasses, 5=5 glasses, 6=6 or more glasses |
| | 8a. How many units of alcohol have you consumed in the last 7 days? | 0=0, 1=1 glass or ‘once’, 2=2 glasses, 3=3 glasses, 4=4 glasses, 5=5 glasses, 6=6 or more glasses |
| | 8b. How many units of alcohol have you consumed in the last 7 days total? | Fill in number, greater than 0, warning by 50 |
| Activity levels | 9. Before the corona crisis, how much time did you spend sitting, on average, per working day (Monday to Friday)? | Don’t know, less than 1 hour, 1 hour, …. 12 hours, more than 12 hours |
| | 10. Before the corona crisis, how much time did you spend sitting, on average, per weekend day (Sat, Sun)? | Don’t know, less than 1 hour, 1 hour, …. 12 hours, more than 12 hours |
11. In the past 7 days, how much time did you spend sitting, on average, per **working day** (Monday to Friday)?

Don't know, less than 1 hour, 1 hour, ..., 12 hours, more than 12 hours

12. In the past 7 days, how much time did you spend sitting on average per **weekend day** (Sat, Sun)?

Don't know, less than 1 hour, 1 hour, ..., 12 hours, more than 12 hours

| Comments | Question | Answer type |
|----------|----------|-------------|
| 1. Do you have any comments regarding this questionnaire? | Yes/No |
| _1. txt. What comments do you have about this questionnaire?_ | Text |

**Groningen Frailty Index**

For respondents 65 years of age and older.

| Question | Answer type |
|----------|-------------|
| 1. Are you 65 or older? We do have this information in our database, but to ensure the rapid processing of this questionnaire, we are asking you to fill this in again. | Yes/No |
| 2. Can you independently perform the following activities without any help from someone else, possibly with the help of a cane, walker or wheelchair? | Yes/No |
| 2a. Get groceries and run errands | Yes/No |
| 2b. Get dressed/undressed | Yes/No |
| 2c. Move outdoors (around house, to neighbours) | Yes/No |
| 2d. Go the toilet | Yes/No |
| 3. What score would give your fitness (from 0 to 10): | Scale from 0 to 10 |
| 4. Do you have problems in everyday life due to poor vision? | Yes, many problems / Yes, some problems / No, no problems |
| 5. Do you have problems in everyday life due to poor hearing? | Yes, many problems / Yes, some problems / No, no problems |
| 6. Have you lost a lot of weight in the past period without wanting to (6 kg in 6 months or 3 kg in one month)? | Yes/No |
| 7. Do you have memory problems? | No/Sometimes/Yes |

**KIDSCREEN**

If household members are <18 years old (questions from the socio-demographic module).

| Question | Answer type |
|----------|-------------|
| How old is your oldest child aged 18 years or younger? | Number |

Complete the following questions for this child for **the last 7 days**:

1. Has your child felt fit and healthy?
2. Has your child felt full of energy?
3. Has your child felt sad?
4. Has your child felt lonely?
5. Has your child had sufficient time for him or herself?
6. Has your child been able to do the things her or she wanted to do in their free time?
7. Has your child felt that he or she has been treated fairly by his/her parents?
8. Did your child have fun with his/her friends?
9. Did school activities go well?
   10a. Has your child been able to pay attention?
   10b. Has your child felt anxious?
   10c. Has your child felt angry?
   10d. Has your child been bored?

11. In general, how would your child rate his/her health? Excellent/very good/good/fair/poor
Table 2. Characteristics of Lifelines participants invited to participate in the cohort and the participants in COVID-19 questionnaire cohort during the first six weeks of the project (Questionnaire rounds 1-6).

|                      | Invited   | Not invited | P-value | Responded     | Not Responded | P-value |
|----------------------|-----------|-------------|---------|---------------|---------------|---------|
| N (%)                | 139,713 (87.6) | 19,769 (12.4) |         | 68,501 (49.0) | 71,212 (51.0) |        |
| Current age, mean (sd) | 51.1 (13.6) | 57.8 (18.3) | < 0.01  | 54.3 (13.0) | 48.1 (13.5) | < 0.01 |
| Male sex, %           | 41.6      | 42.3        | 0.07    | 39.2          | 44.0          | < 0.01 |
| BMI at last visit, mean (sd) | 25.9 (4.3) | 26.5 (4.9) | < 0.01  | 26.0 (4.3) | 25.8 (4.3) | < 0.01 |
| Smoking at last visit, %        |           |             |         |               |               |        |
| never                 | 52.1      | 46.1        |         | 51.9          | 52.4          | < 0.01 |
| ex                    | 32.1      | 37.5        | < 0.01  | 34.1          | 28.8          |        |
| current               | 15.8      | 16.5        |         | 14.0          | 18.8          |        |

Table 3. Characteristics of Lifelines NEXT participants invited to participate in the cohort and the participants in COVID-19 questionnaire cohort during the first six weeks of the project (Questionnaire rounds 1-6).

|                      | Invited   | Responded | Not responded |
|----------------------|-----------|-----------|---------------|
| N (%)                | 321 (100) | 159 (49.5) | 162 (50.5)    |
| Current age, mean (sd) | 33.6 (4.9) | 33.0 (4.3) | 34.3 (5.3)    |
| Male sex, %           | 49.5      | 36.5      | 62.3          |
Supplementary Table 1. COVID-19 infections, hospitalizations and deaths for the Netherlands as whole and for the Northern Provinces. Statistics are as of June 09, 2020. Source: RIVM, downloaded from the CoronaWatchNL Github.

| Region   | Infections | Hospitalizations | Deaths |
|----------|------------|------------------|--------|
| Netherlands | 47903      | 11800            | 6031   |
| North NL | 1491       | 320              | 122    |
| Groningen | 352        | 74               | 17     |
| Friesland | 616        | 130              | 65     |
| Drenthe  | 523        | 116              | 40     |