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The influences of the Covid-19 pandemic on Swedes' activity and travel behaviour

Master's thesis in Infrastructure and Environmental Engineering

ADAM GUSTAFSSON

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Infrastructure and Environmental Engineering
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Gothenburg, Sweden 2021

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ADAM GUSTAFSSON

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Supervisor: Dr. Kun Gao, Department of Architecture and Civil Engineering
Examiner: Prof Xiaobo Qu, Department of Architecture and Civil Engineering

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Department of Architecture and Civil Engineering
Division of Infrastructure and Environmental Engineering
Chalmers University of Technology
SE-412 96 Gothenburg
Telephone +46 31 772 1000

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ADAM GUSTAFSSON
Department of Architecture and Civil Engineering
Chalmers University of Technology

Abstract

The impact of Covid-19 is determined by, not only the infection and death rate of the actual disease, but the restrictions implemented to halt its spread. The impact these restrictions have is different from country to country, but also when the restrictions are implemented. A summary of Sweden's restriction timeline has therefore been presented, showcasing that Sweden's approach increases restrictions throughout the pandemic. A survey was then made, outlining two different pandemic periods, based on the knowledge from the literature study that travel behaviour changes due to restrictions implemented. The survey included questions about mode choice, activity, and travel choice for different purposes, as well as risk perception and health and wealth. The results show to a great extent a decline in public transit usage and frequency of engaging in activities. This is met by an increase in working from home, shopping online, and ordering food. The overall risk perception is very high. This is with regards to the different environments, public transit, public locations, and physical meetings, which serves as the underlying reasons for many of the behavioural changes we have seen in those categories. Understanding what provoke these changes will prove to be valuable when looking at if they continue. Most behaviours show that they will get back to their pre-pandemic figure, like public transit to some extent. Meanwhile the results clearly show that when it comes to working from home, it is expected to continue at a much greater rate than before the pandemic. Overall, the thesis provides important knowledge when it comes to the pandemic and its impact on citizens behaviour.

Keywords: Covid, travel, behaviour change, Sweden, pandemic, mode choice, survey.

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1

Introduction

This chapter will provide background to the thesis, introduce the aim, and what objectives will be answered by the result. It also includes a restriction timeline, which serves as the backbone for the Swedish approach to the Covid pandemic management.

1.1 Background

The Covid pandemic will have changed the world forever. As of today, more than 3 million people are dead from the virus, and more 150 million infected globally [1]. In Sweden, the number of cases amounts to roughly 10% of the population [2]. The virus impact is global, will have long-term implications, and strategies to combat it varies. These strategies vary from region to region, country to country, and as of today it is uncertain what strategy is most successful in halting the spread of the virus. What is certain however, is that these strategies universally implicated some sort of restriction in mobility, social distancing, and cap on amount of people at gatherings etc [3].

In the limited number of studies covering the impact of the Covid pandemic there is evidence to support that these sorts of recommendations have successful implementations [4]. Using cellular data, there has been reported a 64 percent increase in population in residential areas during working hours, as well as a 33 percent decrease in daily activity at industrial sites in Sweden [5]. However, these reports of aggregated data lack the detail when it comes to mode choice, activity, and travel choice for different purposes and how these has changed. Therefore, this thesis aims to shed a light on these changes.

For countries with the lock-down approach, travel behaviour is forced to change. In Sweden however, due to amendment rights, the government cannot enforce lock-downs, even in times of crisis [6]. Therefore, the Swedish government, in union with its public health authority, relied heavily on self-restriction recommendations like social distancing, limits to public gatherings, and advising the public to not take unnecessary trips and work from home. The implications this will have on travel behaviour is not as clear cut as when enforcing lock-downs. There are still necessities like online shopping and socializing online which may find a surge in users due to the pandemic.

There are also questions about how these changes will persist after the pandemic. Will citizens stick with their new travel habits? If more people start working from home there is promise for a decrease in emissions and congestion, especially during peak-hours. There is also the case in which private vehicles might see a rise due to it being less exposed to other commuters. Will there be an issue with more cars on the road, due to it being safer than public transit? All of this is important for city planners and authority to be aware of, especially if these behaviours persists past the pandemic.

1.2 Aim

This thesis aims to enlighten the influences of the Covid pandemic on daily mobility patterns, like activity and travel choice for different purposes. The investigated travel behavior involves two aspects: activity pattern and travel mode choices. Special attention will be paid to the relationship between risk perception and socioeconomic factors like gender, income, and occupation.

1.3 Objectives

- Develop a tailored survey to reveal to what extent people adjusted their daily travel behaviour during the pandemic
- Investigate to what extent mode choice, activity and travel choice for different purposes have changed in different periods
- Investigate the relationship between the change in behaviour and risk perception. Also, effects on the perceived well-being, financial and physical health
- Investigates the disparities in effects of the pandemic on different groups
- Make a prediction to what extent these behaviours will continue after the pandemic, and the potential impact on emissions

1.4 Social and ethical aspects

The Covid pandemic has hit the world hard. To handle the spread of the virus, nations and governments have used different tactics to halt its devastating impacts. Not just the pain and suffering due to the disease, but the restrictions have had a very negative impact on the everyday life of each citizens. People's health, physical as well as mental, has been damaged. This is of course a very delicate matter.

This thesis will be one small part in the expanding net of research regarding the topic of travel during Covid. The result of the thesis is meant to guide future research, as well as pinpoint an effective way of steering through a future ravaging pandemic. The results are not meant for miss-use or furthering any agenda.

1.5 Restriction timeline

When the news of the virus spread across the world, uncertainties were high. The world had not had a looming pandemic of this scale since the Spanish plague, circa 100 years ago. To combat the unprecedented spread of the virus, nations and their government acted swiftly with measures to decrease the risk of further spread. These measures included travel bans, quarantines for arrivals from infected nations, social distancing, and lock-downs. Sweden's approach was more casual than other countries. With the first confirmed case in late January, it took authorities a month to start acting. To not suffer the consequences of a lockdown, a stagnant economy, authorities focused on the message of "wash your hands" and social distancing measures [7].

To notice the change in behaviour it was decided to divide the pandemic periods in parts to notice if behaviour changed throughout. This split was decided on a basic understanding of the situation in society, as well as own experience. It is divided as per the figure 1.1, which showcases the timeline and its different stages. The before period is before February, which is when Covid had not reached Sweden yet. The first pandemic period is between March and July. This time is where most of the restrictions were put in place, only to get stricter. The third period includes a lot of the summer months, where the death rate was low. These months could have been excluded, since not many restrictions were put in place, and society functioned differently due to vacations and such. The later part, around December is where a lot stricter restrictions were put in place. The second pandemic period extends from July to Mars. There is also a fourth period added to obtain data in a future scenario where the pandemic is no longer an issue.

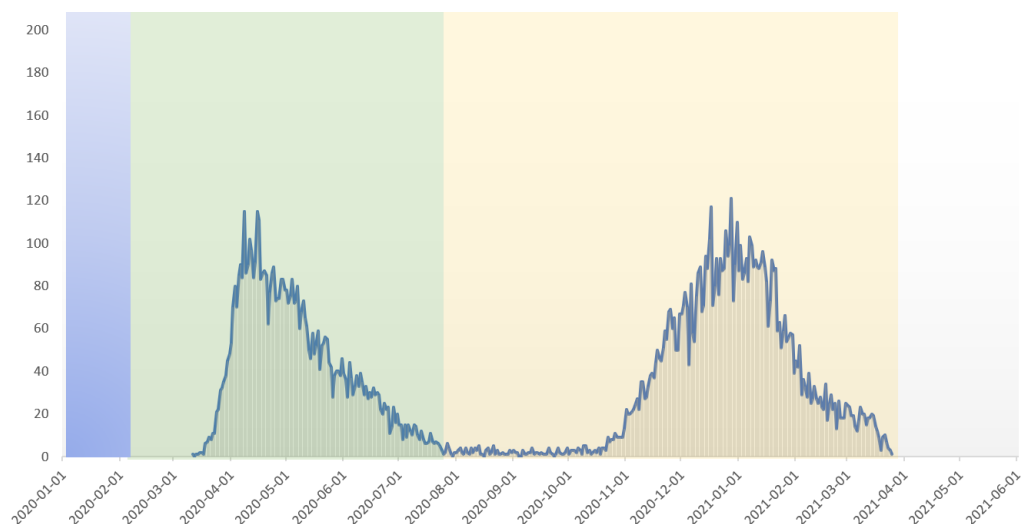


Figure 1.1: Timeline of the death toll in Sweden, with the color representing the different pandemic period to be studied. Pre-covid (blue), 1st pandemic period (green), 2nd pandemic period (yellow), and future period (white).

The public health organisation sent out a PSA via text on the 14th of December, referring to the website krisinformation.se for further information [8]. With this came a fundamental change in managing the spread of the virus. These new restrictions put responsibility on all citizens to take measure in protecting themselves and others from the spread of the virus. What earlier was seen as advice, now became an obligation for citizens to follow. Later in December, a way for shop and business owners to limit the number of visitors based on the size of the establishment were introduced. On Christmas eve, a limit to 4 people per table was introduced at bars and restaurants.

On the 10th of January 2021, the government introduced legislation which made it easier to enforce restrictions, the so-called "pandemilagen" [8]. This law enables the government to force closings of shops and businesses if safety in spreading cannot be ensured. It also introduces punishment if you break the restrictions that are put in place. This law is set to span until the end of September 2021.

All in all, it is believed that citizens experience life differently in the early days of Covid compared to the later parts of Covid. This due to the increase in restrictions, in the later part, but also a sort of conforming and change in expectation on life during a pandemic.

There are a number of events that took place in the pandemic period, which resulted in the implementation of various restrictions:

- 31 January 2020 – First confirmed case of Covid in Sweden
- 10 Mars 2020 – Public health authority raises the risk of spread in Sweden to very high. Restrictions to gatherings of more than 500 people are put in order
- 11 Mars 2020 – First confirmed death from Covid
- 12 Mars 2020 - Public health authority adopts the “flatten the curve” approach
- 14 Mars 2020 – State Department imposes restrictions for travel all together
- 16 Mars 2020 - Public health authority urges people over 70 to stay at home
- 17 Mars 2020 - Public health authority urges education of higher learning to be made from home
- 19 Mars 2020 – The government introduces ways to close elementary school
- 24 Mars 2020 – Only silver service is allowed in bars and restaurants
- 27 Mars 2020 – The restrictions on gatherings are tightened to 50 people
- 1 July 2020 – A new law is introduced that puts the responsibility on the restaurants to uphold current prescriptions in place
- 7 July 2020 – New prescriptions for restaurants to follow such as to only serve guests that sit down and to offer hand sanitizer
- 14 December 2020 – Harshened restrictions on gatherings, travelling, and shopping is introduced via text from the public health authority
- 23 December 2020 – A limit to the amount of people visiting a shop, gallery, or gym should be set
- 24 December 2020 – Limit to companies at restaurants set to 4 per table
- 27 December 2020 – First vaccine does is administered

- 7 January 2021 – Masks are recommended during rush hour on public transports
- 10 January 2021 – New pandemic law is introduced
- 10 Mars 2021 – 1 million vaccine doses have been administered

2

Literature study

This chapter explores the already researched topic of travel behaviour during the Covid pandemic. This is to understand and compare different methods and techniques used around the world to understand the pandemics impact. It also details the already made changes to people daily travel behaviour, for several parts of the world. Lastly, Sweden's travel habits will be studied, this is important to understand when discussing the changes Covid will have. This will later be used to develop the method and will be of great help to interpret the results.

2.1 Travel behaviour in the Covid pandemic

The amount of research regarding Covid's impact on travel behaviour increases as the pandemic progress. The research will prove to be valuable when trying to understand how things such as perceived risk of virus spread, implementation of restrictions, and the discrepancy between different countries approaches effect behavioural patterns. It is crucial to understand that countries social norms are deciding in the effectiveness of a governments approach to handling the pandemic, as well as how its perceived amongst social groups to follow these restrictions [9].

When these social influences are subject to change, due to extraordinary events such as Covid, we can observe changes in behaviour [10]. Giancarlo Parady, Ayako Taniguchi, Kiyoshi Takami (2020) found that for Japan, risk perception can be associated with "non-negligible increases in the probability to stay home and the probability to reduce trip frequencies". For things like grocery shopping this means that some regularity will still be achieved, with the help of protective measures such as masks and social distancing, as well as due to its necessity. Findings also suggest that Japans approach of "non-binding requests and soft measures", because of the lack of legal mechanism for the government to enforce lock downs, are more effective if the threat by Covid is properly conveyed, and also appeal to the group rather than the individual.

Abdullah, M. et.al's (2020) global study on travel behaviour and mode preferences found that respondents, when choosing travel mode during COVID, placed a significant emphasis on infection related factors. This included share of passengers with face masks, ease to distance, cleanliness, and concern for infection. Things that dictate travel mode choice under normal circumstances such as travel time, cost, comfort, are not as prioritized. These characteristics have a significant association

with travel satisfaction [11]. Where disruptive event like Covid, trigger change in these patterns, travel satisfaction is an important component to behavioural changes.

De Vos, J. (2020) was early in predicting how people would respond and behave due to implemented restriction, particularly to social distancing measures. His predictions entail that social distancing might decrease travel demand due to an "increased amount of working from home, e-learning, and a reduced number of public activities and events". Regarding mode choice, public transportation is expected to see a decrease in demand, due to its uncertainty in allowing for social distancing. This in turn will see that people with access to car will use it more often, but that we might see an overall decrease in kilometers driven per car. Also, that active modes such as walking and cycling is expected to increase, this because social distancing can easily be upheld. De Vos continues to predict how these changes will impact well-being. With the restriction to perform out-of-home activities, which are necessary to maintain a functional social well-being, we might see an increase in mental health issues. Potentially this will provide motivation for more travel without a destination. Studies have shown that active travel modes have shown results in positive emotions, which would hopefully increase in times like these. We might see an increase in recreational travel activities, such as jogging, cycling, or walking, to maintain a certain level of well-being. De Vos concludes that policymakers have a responsibility in providing more open and green spaces for citizens to have access too, without the need to access them by traveling.

With the overall reduction in travel demand due to restrictions in social interaction we see an overall increase in working from home, or telecommuting [4, 12]. This transition to more virtual workspaces is what has allowed some businesses to continue to operate during the pandemic period. Shamshiripour, A. et.al's (2020) [12] study on the city of Chicago, found a positive association with people who started to work from home during the pandemic. This is then something that could continue after the pandemic, which could have potential for a more sustainable future, promoting less travel demand, alleviating congestion, and reducing air pollution [13]. Beck, M. and Hensher, D. study on Covid in Australia further this notion. They urge policy makers to, using policy, ease for further increase the probability for propensity for working from home [14].

Rebecca Brough, Matthew Freedman, David Phillips (2020), found that "Even after accounting for mode substitution and differential public transit service reductions, travel intensity declined less among less educated and low-income individuals" when looking at King County, Washington, one of the first breakout counties in the United States to implement lock-down [15]. They raise the concern that less educated, and lower income earners are less able to perform their work from home. They also express that the gap in travel behaviour between the socioeconomic groups persists, even after the lock-down. There is also a decline to public transport, which may lead to increased emission and congestion. However, this may be mitigated by some companies choosing to continue working from home if possible, even when the pandemic is over. This could cement the gap between the socioeconomic groups even further,

to which the paper suggests "Pandemic mitigation policies targeting work-related travel" to combat this.

Travelers are also expected to present some inertia to their behaviour pre-Covid. This inertia stems from repeated past behaviour which influence our current and future behaviour [16]. This behaviour, past, current, and future, is influenced by personal attributes (socio-economic parameters), psychological and behavioural factors (attitudes, norms, perceptions), and situation related factors (time, cost, comfort). Experiences from past behaviour also create a rational preference which influence this current and future behaviour. Research have shown that, for both car and metro users, there is a substantially larger predilection for previously used transport mode in mode shift scenarios, than in new context mode choice scenarios. Which the first mentioned could be applicable for Covid.

For Covid, all of these parameters are subject to change. How much this inertia plays a part in mode choice during Covid is important to understand. Eeshan Bhaduri, et.al [17] states that the extent of inertia differs between trip purpose and trip lengths for India. Overall, for commuting purposes, for some modes there is a positive inertia towards using the same mode as pre-Covid. Here, the private modes (motorbike and car) have the highest inertia to the other modes. This is due to higher levels of comfort and flexibility, but also the fact that it is private and separate reducing the risk of being infected with Covid. For commuting the respondents is said to have a "greater stickiness" for higher trip lengths, mostly using personal vehicles. Commuters travelling greater than 5km are 2.5 times more likely to stick with their car, compared to shorter distances. This trend is somewhat applicable to shared vehicles as well. For discretionary trips, the inertia is similar to commuting. Fewer modes display the same level of inertia, and the greater distances traveled yields a greater inertia. The same is said for shared vehicles, that the inertia is lower than for private vehicles.

2.2 The derivative effects of the pandemic on emission

With the implementation of an array of policies and restrictions by governments to combat the pandemic, the patterns of energy demands have been altered [18]. It is estimated that the daily decline of emissions reached 17% globally early on, when the first wave of the pandemic hit. Half of this decrease in emissions is said to be accounted for by surface emissions. This is believed to be due to the favourable attributes with active travel such as walking and biking. However, most of these changes are believed to be temporary. It is not found that the social response alone, of confinement and restriction, is enough to last beyond the pandemic period.

The concept of longevity with the decrease in emissions is furthered by the study "*Transportation CO₂ emissions stayed high despite recurrent COVID outbreaks*" which found that daily emissions dropped by 34.5% in April 2020 in Europe [19].

This decrease is believed to be due to the very prominent restrictions throughout Europe imposed with the first wave. When the second wave hit, the decrease in emissions only reached 5.2% in November. With the second wave, restrictions in Europe were overall less stringent, but citizen had also found a way to live with the restrictions in place. Overall, the study reveals that the amount of cases, number of dead, or government restrictions are not a reliable indicator for predicting decreases in emission. The study states that "European ground transportation emissions will return to normal levels in 2021" and the pandemic will have had little effect in changing the travel behaviour at all.

According to Swedish Transportation Administration, preliminary figures on the decrease in road emissions 2020 reached 9% [20]. Of this, 90% is believed to be due to the pandemic and its impact on travel. However, what long lasting effects the pandemic will have on travel behaviour is hard to estimate.

2.3 Sweden's travel situation in 2020

Sweden prides itself with being a transforming country when it comes to sustainable travel. Its long history with car manufacturing as well as the bold Vision Zero, with regards to traffic deaths, a lot of thought is put into how Swede's travel. To better understand the eventual impact of Covid on Sweden's travel behaviour, it is important to understand the numbers before the pandemic hit. In 2019 4,3 billion main trips were made ([21]). Main trips are trips made with one or more modes, where one or more matters are made, which end at either a workplace, school, or home. Of these, more than half were commuting trips. The distribution of modes consist of about half the trips is made by car, 19% are made by public transport, 14% by walking, and 12% by bikes. When looking at the differences between the genders, there is not much discrepancy between the travel destination, however when it comes to kilometers traveled by mode, women travel twice as far by public transport than men, meanwhile men travel a bit more kilometers by car each year [21].

Moving on to Sweden's situation during 2020 there is not much information published yet. One of the only cities to do so proficiently is Göteborg Stad. Göteborg is Sweden's second largest city, with about 800 000 inhabitants, meanwhile the region surrounding Göteborg includes more than 1.7 million [22]. Their report of their traffic and travelling development gives insight to how travelling changed during Covid in one of Sweden's largest regions. It also includes more information such as how many worked from home, consumption patterns, and how social distancing forced cities to rethink travelling [23]. One of the booming businesses which saw an increase in 2020 was food delivery and e-commerce which saw a 40% increase over the year, and by the end of the year more than 8 out of 10 Swedes used online shopping. This of course effected the use of freight traffic in the city. In one of their annual surveys about attitude towards bicycling (conducted in September), more than half of the city's residents worked from home at least one day a week. Of these, a few more were men and younger people. This study also contained change

in the number of trips for certain purposes. It was reported that about half of the citizens made fewer work trips, fewer shopping trips, and 7 in 10 people made fewer leisure trips.

One of the most essential part of their report display the change in travel by each mode 2020, compared to 2019. According to their data, all travel decreased by 16%, with only biking increasing by 8%. The other modes change was -24% by foot, -6% by car, and -31% by public transport. This was the first year in 40-50 years that travelling declined by trips per person. The report states that this is a positive effect on the congestion and emissions for the city.

The report also includes some information about how the citizens will act after the pandemic is over. About a fourth of the population say they will work more from home than before the pandemic, almost the same amount says that about shopping online as well. For mode choice, 30% say they will use public transport more than before the pandemic, but one in five say they will not. According to the report, it is the age group of 30-49-year old's who mostly will not use public transport as much, the same age group which have chosen the bike during the pandemic, and is said to do so after the pandemic as well.

2.3.1 Summarize

It becomes apparent that there is a lack of substantial research, which is understandable since Covid only hit about 12 month ago. There is evidence to support that travel behaviour have been impacted greatly. A decrease in travel frequency, with a mirrored increase in staying at home, due to various restrictions is noted in almost all of the studies mentioned above. When it comes to mode choice, public transit has seen a considerable decline due to its more exposed nature, meanwhile active modes have seen an increase.

Evidence suggests that due to these behavioural differences, there have been a positive impact in the form of decreased emissions. To which extent this decrease will continue or even sustain before the pandemic is over is unclear, but the sources mentioned here do not seem keen on believing that behaviour will not go back to normal, even before the pandemic is over.

In Sweden, there has also been a change to our travel situation. For Sweden's second largest city, Göteborg, the decline in travelling reached 16% last year, with a reduction in public transit by almost a third. It was also reported a fourth of the population will work from home more after the pandemic, almost the same amount would continue shopping more online.

There is however a clear lack of knowledge in the case of how these behaviours continue beyond the scope of the pandemic period. Some of it is encouraged to stay, like working from home, driving down the peak-hour traffic and emissions.

2. Literature study

The restrictions impact socio-economic groups differently, due to differences and biases in behaviour created by pre-requisites. It is therefore important that the implementation of restriction is done delicately.

3

Methods

This chapter will present the methods used to achieve the aim of the thesis. The theory have already been established in chapter 2. Survey design is an important step to gather sufficient data and will be detailed in section 3.1. This is followed by surveying, which is where the data is gathered. Analysis will be based on the data sample with input from the theory. Further, we will present the results in chapter 4. Below, there is a simple schematic image (see figure 3.1) showing the workflow for the thesis.

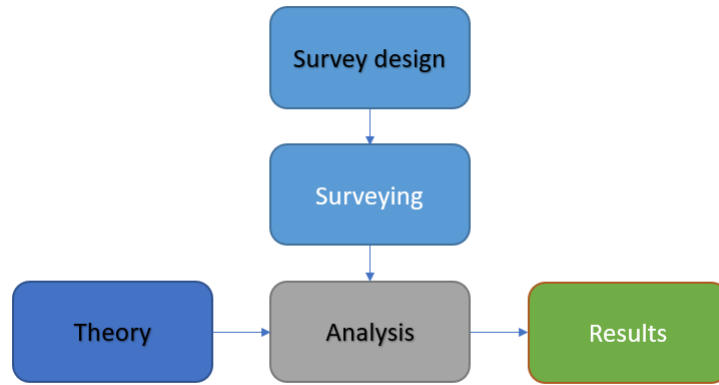


Figure 3.1: Schematic figure of the process

3.1 Survey design

The survey was extensively developed in collaboration with Dr. Kun Gao. It was developed in Google Forms, using a skin from www.formfacade.com. A skin was used for to ease the use on both computer as well as mobile platforms. The survey contains 50 questions, covering: (1) four time periods, (2) attitudes and risk perceptions, (3) socio-demographic characteristics. Since the purpose of the thesis is to find the change in behaviour, four time periods were used. One pre-Covid (before February 2020), one in the beginning of the pandemic (February 2020-July 2020), one spanning to now (July 2020-Now), one hypothetical post-Covid period. The Covid period is split in two due to the significant change in restriction implementation as well as severity increase of the virus occurring between July 2020-Mars 2021.

All time periods contain questions about employment in the specific time period, amount of working/studying days per week, frequency of working from home, then frequency of engaging in shopping and leisurely activities. This is followed up with mode choice for commuting, shopping, and leisurely activities. The survey is also divided into sections so that, for example, if you answer that you were retired or was not employed during a period, you do not get furthered asked questions about your commuting habits. The questionnaire can be found in Appendix A.1.

When the change of the behaviour is established, it is important to understand why this behaviour change occurred. Therefore, the second part of the survey contains questions about attitudes and risk perceptions related to the pandemic. Here, the respondents answers if they have been infected by Covid, and/or if friends/acquaintances have been infected, and the severity of their symptoms. This is followed up with questions on how the pandemic have affected physical activities, well-being, and financial situation. Lastly, agreement with statements about the pandemic, its spread, and impact, as well as perceived risk in different environments and situations. The perception of risk is expected to be the deciding factor in whether or not restrictions and regulations are being followed, as well as what precipitates the change in behaviour.

This, in addition to the socio-demographic characteristics is meant to outline the potential reasons for the behavioural change. The characteristics contains gender, age, nationality, highest completed education, household situation, income, and employment status. The entirety of the survey can be found in the Appendix A.1.

When distributing a survey, it is crucial that none of the respondents take offence with the questions, as well as keep their answers anonymous. When distributing a survey like this all sorts of people are bound to answer. Therefore, the language and message of the survey must be easy to follow and answer, so all socioeconomic groups can be included. Since people are at the center of our data, attaining a diverse and well distributed sample group is important for analysis and reaching solid conclusions.

3.1.1 Pilot survey

A pilot survey was deployed the last week of February 2021. This highlighted a few issues, but most importantly confirmed the validity of the surveys data. There were clear results showing change in behaviour by respondents. One key feedback from the pilot survey was the issue that the survey was long and tedious. Some questions down-sized, some things were rearranged like the socio-economic part was put in the back so that more focus was put on the period-related questions. Most importantly a decision was made to translate the survey to Swedish. It was believed that distributing a survey in a country with its native language looked more prominent of gaining more and better answers. The pilot survey helped in solidifying the layout of the questionnaire, proving that with a larger sample pool, further analysis could be made.

3.1.2 Head survey

After the corrections from the pilot survey was completed, the head survey could be deployed. The survey was deployed from 17th of Mars using different social media platforms (Facebook, Twitter, LinkedIn), individual social groups (mail lists, friend, family) and resulted in 380+ answers in about three weeks.

3.2 Analysis

The data was sorted in Excel, removing incomplete answers and answers from outside of Sweden. Some general distribution was derived from the Pivot table function in Excel. The values are then prepared and plotted in figures, where the shares are properly colored to visualize the change between the different pandemic periods, and/or statements. This serves as the basis for the results, which are then put into Overleaf as figures.

To analyze the mode choices, it was decided that each mode from the questionnaire were to be grouped up with similar modes sharing the same characteristics. For private vehicles, these include private car and motorcycle due similarities in cost and operation. Public transit is left as is, and active mode includes walking, bicycles/scooters (both private and shared) due to their usage being free from exposure to others. The focus of the mode choice results will be around whether the value of public transportation have changed substantially or not.

The results are then presented and described in chapter 4 and some analysis is made as per the basis for the results. The results are then discussed further in chapter 5. Further analysis is made with socioeconomic factors such as gender, income, and occupation being observed separately. The gender distribution allows for easy insight in the differences between the gender. Income and occupations can serve as complementary analysis since they are connected to some degree. Income is grouped after OECDs standard, with low income and poor being paired due to lack of sufficient data [24].

Occupation will be sorted by essential and non-essential jobs. This will be based on which primary sector the respondent belonged to before the pandemic. Since there will be a diverse pool of answers, the issue arises how to sort them. Essential jobs will be defined as jobs that are required for a society to still function, however we will also try to look at restrictions in place and from own experience, to figure out whether these jobs have been able to continue without any measures made due to the pandemic. The sectors that meet these requirements for essential jobs are:

- Services (e.g., transit company, grocery retails, shops, and restaurants)
- Healthcare (e.g., doctor, nurses, and paramedic)
- Construction and maintenance (e.g., plumber, building worker, gardener)
- Teaching and education
- Public organizations or authority

- Military

Meanwhile, the sectors that meet these requirements for non-essential jobs are:

- College graduate, Master, or PhD student
- Management, consulting, finance
- Private employed
- Researcher
- Media
- Non-profit activities
- Industry employee (e.g., automotive, IT, manufacture industry)

This distinction for occupations is made to better highlight to what extent differences in behaviour these jobs reach. Essential jobs are often more demanding, have lower pay, and women are the majority of the work force [25]. Also, the following categories were excluded from the occupation classification: retired, not employed and not looking for work, not employed but looking for work, due to not relevant nor statistically insignificant.

For the socio-economic analysis, only a few of all the questions are being analyzed with regards to importance and impact on to each socioeconomic group. Things such as mode choice commuting, frequency of working from home, and engaging in leisurely activities is seen as central to this thesis aim and are therefore pursued. The well-being and financial situation change, as well as risk perception is also an important factor to understand the impact that the pandemic has had, and how it has changed in different socioeconomic groups is a tool to understand how these changes has impacted them.

Conclusions are then based on and compared to the litterateur study. To full-fill the aim of this thesis, a lot of information must be gathered and analyzed. However, due to sample size in some areas, these conclusions might not be reliable. These are therefore made with the thought of reaching some conclusions rather than not basing them on anything at all.

4

Results

In this chapter the results from the survey will be presented. The main focus of this chapter will be the presenting of the results of the head survey, including the different activities, risk perception and Covid impact, and disparities between different groups.

4.1 Formal analysis

This section presents all of the results from the survey. No further division has been performed on the data.

4.1.1 Socio-economic distribution

The socio-economic characteristics can be found in table 4.1. These figures are overall well distributed and will not be altered to match Sweden's current demographic. However, the impact of this discrepancy over the results will be discussed in Chapter 6. The sample of genders is almost split, with a few more males (52%) than women (47%). Half of the respondents are between the ages 45-65 (50%), followed by 30-45 (29%), 18-30(17%), and >65(3.5%). More than 66% have a Bachelor's degree or higher. An overwhelming majority (76%) belong to the middle class, with low income/poor- (14%) and high-income earners being in the minority, with no income respondents (2%). For occupation, the distribution leans in the favor of the essential workers with 60% and non-essential reaching 40%.

Table 4.1: The demographic statistics from the survey

Sample characteristics		
Independent variables	Sub-categories	Sample distribution
Gender	Male	193 (52%)
	Female	176 (47%)
	Prefer not to say	1 (<1%)
Age	18-30	64 (17%)
	30-45	108 (29%)
	45-65	185 (50%)
	>65	13 (3,5%)
Education	No completed education	1 (<1%)
	High school	111 (30%)
	Bachelors degree	140 (38%)
	Masters degree	89 (24%)
	Professional or doctor-ate degree	15 (4%)
	Other	14 (4%)
Individual income	Low income/poor	50 (14%)
	Middle income	283 (76%)
	High income	29 (8%)
	No income	8 (2%)
Occupation	Essential	209 (60%)
	Non-essential	138 (40%)

4.1.2 Commuting

In the mode choice for commuting an expected decrease of public transit is noticed (figure 4.1). The number of public transit usage falls from 34% to 18% in the 1st period, then 16% in the 2nd Covid period. This is probably due to the timeframe being quite narrow when you use public transit, with peak hours often packing more than what would consider safe during Covid, exposure-wise. The figure increases again in the post-Covid period, pointing to some sort of willingness to continue commuting by public alternatives. This change is distributed almost equally, with private vehicles gaining slightly more in the 2nd period, (3% increase from the 1st period), where active modes see a slight decline (1%).

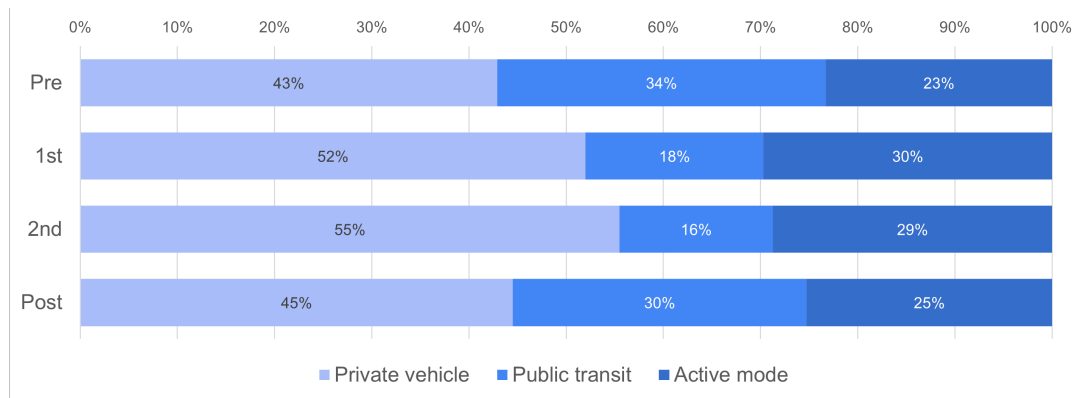


Figure 4.1: Share of mode choice commuting in each studied period

The frequency for working/studying from home changes a lot throughout the period (figure 4.2). The initial amount of people who never worked from home exceeds the majority of the total responses. This figure decreases dramatically throughout the pandemic period reaching 24% in the 2nd period. The figure lands on 36% in the post period, indicating a shift for some of the population in ability to work from home. The figure of "Almost every day" increases the most, going from 3% to 27% and 34% in the 1st and 2nd period of the pandemic. It ends up on 4%, indicating that most respondents might not see themselves working from home every day, but at least more often.

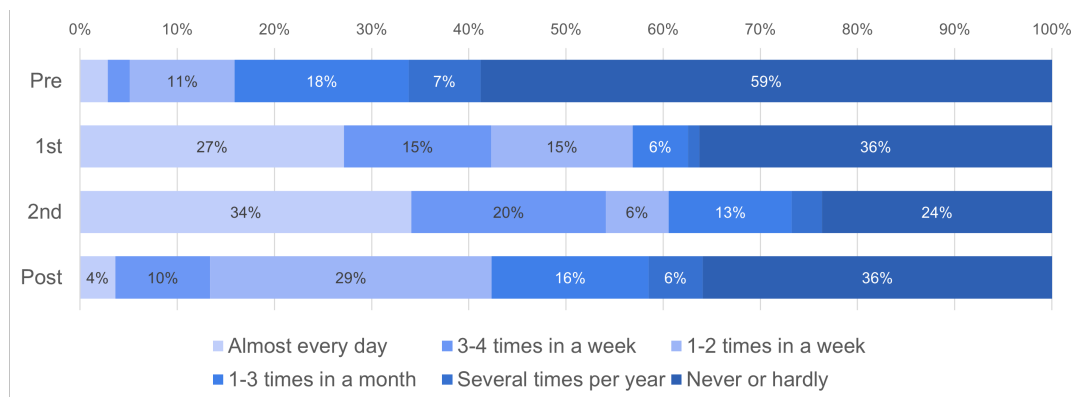


Figure 4.2: Share of frequency of working from home in each studied period

4.1.3 Shopping

The mode choices for shopping are much more stable, almost exclusively falling within 5% of each other throughout the periods (figure 4.3). Here, private vehicles are much more prevalent than when commuting. This is probably due to the ease and comfort of travelling with bags and not having to carry it home from the store.

4. Results

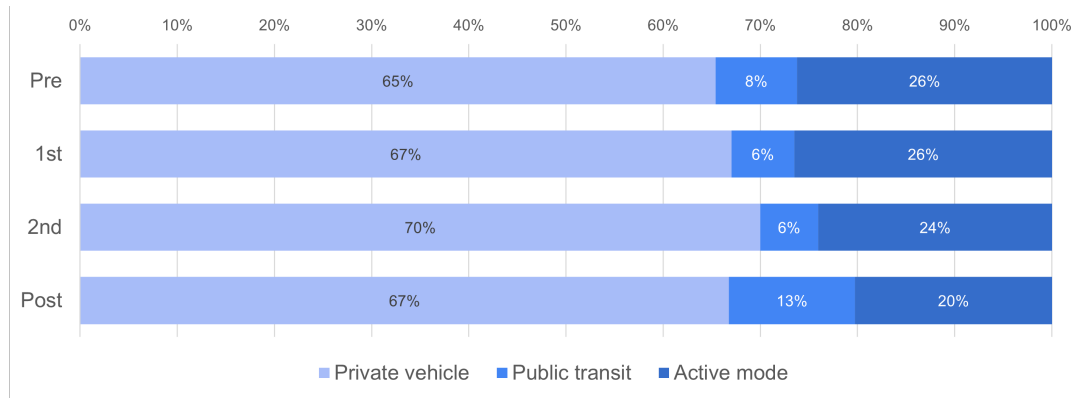


Figure 4.3: Share of mode choice shopping in each studied period

The numbers for shopping frequency indicate that the respondents changed their frequency to less often (figure 4.4). There is a certain shift between the pre-period and post-period with a decrease in shopping "3-4 times a week", from 38% to 24%, as well as an increase in shopping "1-2 times a week" and "1-3 times per month" 8% and 6% respectively. The pandemic period might have forced new ways of shopping less often, a habit that is economically.

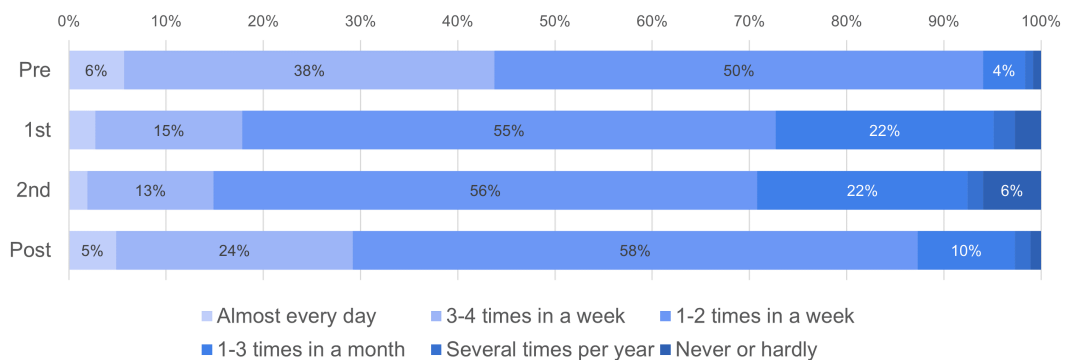


Figure 4.4: Share of frequency of shopping for groceries in each studied period

There is a radical change in the frequency of eating at restaurants (figure 4.5), with more than half of respondents answering that they never or hardly dines at restaurants in the Covid periods (58% in the 1st pandemic period, 62% in the 2nd). The figure pre- and post-Covid however is similar. Between the pre- and post-period, the difference in weekly dining is negligible. However, the change in answer "1-3 times per month" almost increases by 10%. This might indicate some sort of recoil effect in the post-pandemic period, with people wanting to engage in dining at restaurants more often, since it was difficult to motivate in the pandemic periods.

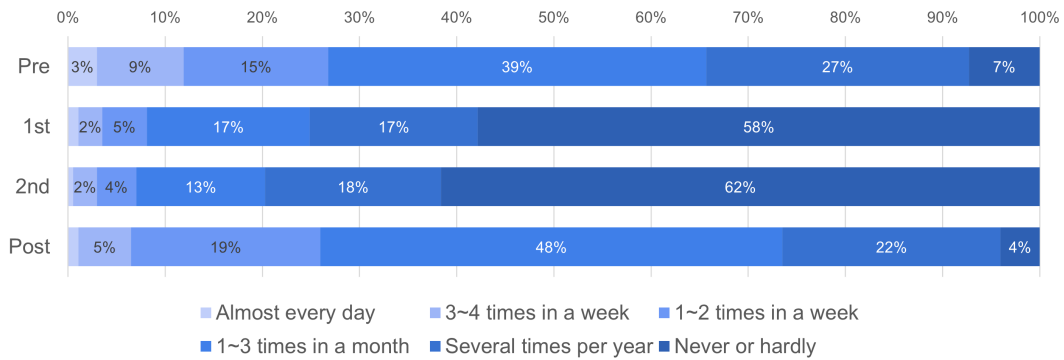


Figure 4.5: Share of frequency of eating at restaurants in each studied period

The choice of ordering delivery food sees a small rise in frequency in the Covid periods, however no substantial change between them (figure 4.6). These figures seem to persist in the post-pandemic period, but with a lower frequency. There might be habits created during the Covid-period, that sustain the pandemic.

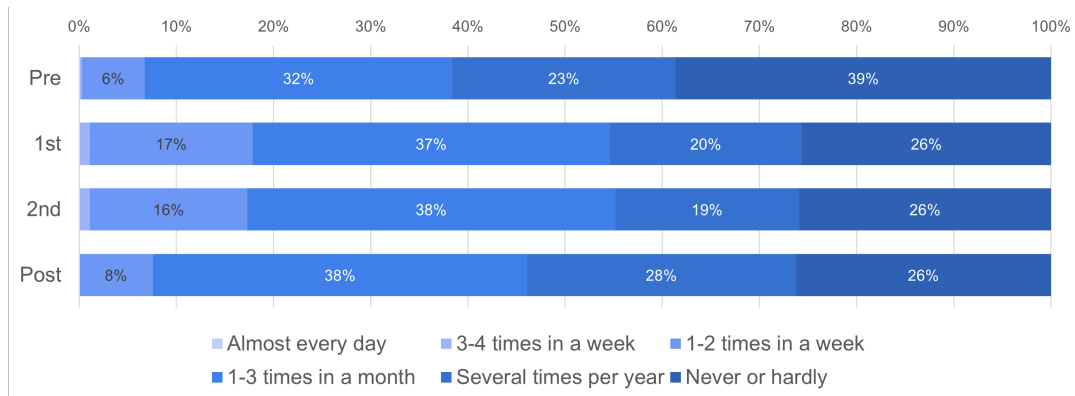


Figure 4.6: Share of frequency of ordering delivery food in each studied period

The frequency of ordering groceries online also sees a bump in frequency during the pandemic (figure 4.7). This may be due to the decrease in frequency of shopping for groceries conventionally. The figure of "Never or hardly" shopping groceries online declines from 63% to 48% in the pre- and post-periods, seeing a further decline even from the 2nd pandemic period (49%).

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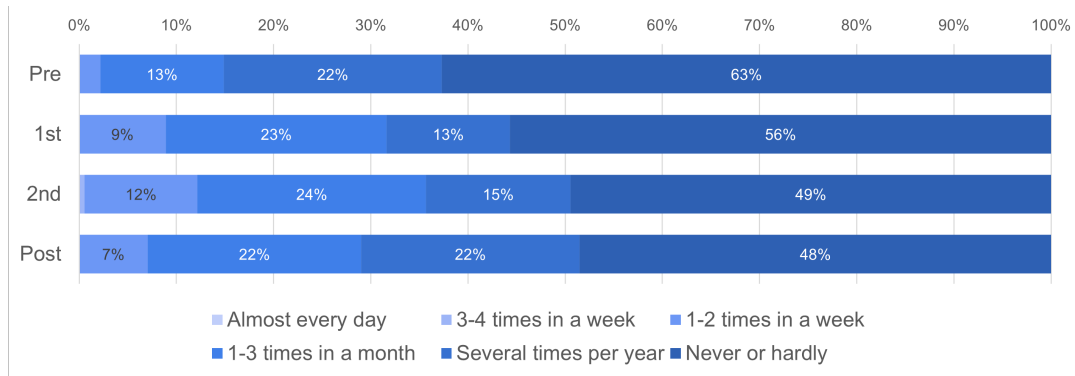


Figure 4.7: Share of frequency of ordering groceries online in each studied period

4.1.4 Leisure

As for mode choices for leisure, the discrepancy is larger compared to for shopping (figure 4.8). Here the public transit alternative decreases in the Covid periods similar to the commuting case, reducing by half between the pre-period (19%) and the 1st period (10%), down to 8% in 2nd period, and almost recovering to the pre-Covid figure in the post Covid period (16%).

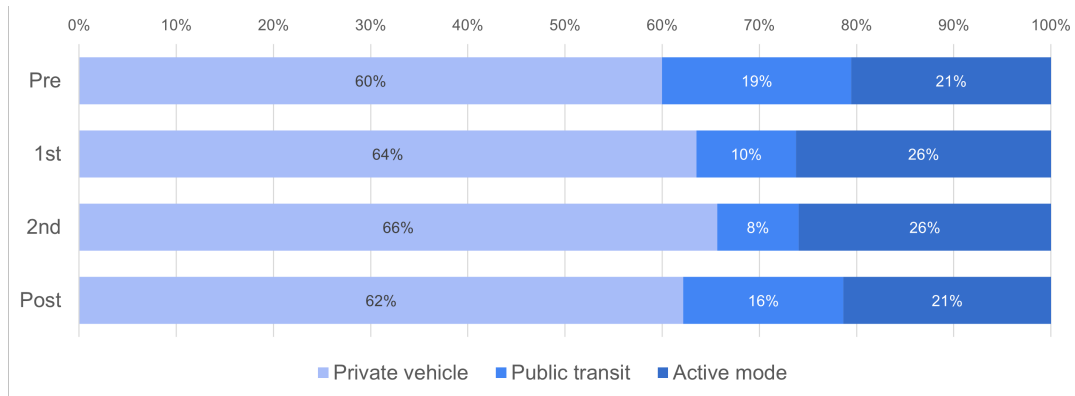


Figure 4.8: Share of mode choice for leisure activities in each studied period

The frequency of engaging in indoors activities sees one of the most rampant changes (figure 4.9). More than half of respondents say they never or hardly engaged in indoors activities during the pandemic periods, similar to the dining at restaurants figure. This indicates that respondents perceive the activity in a similar fashion.

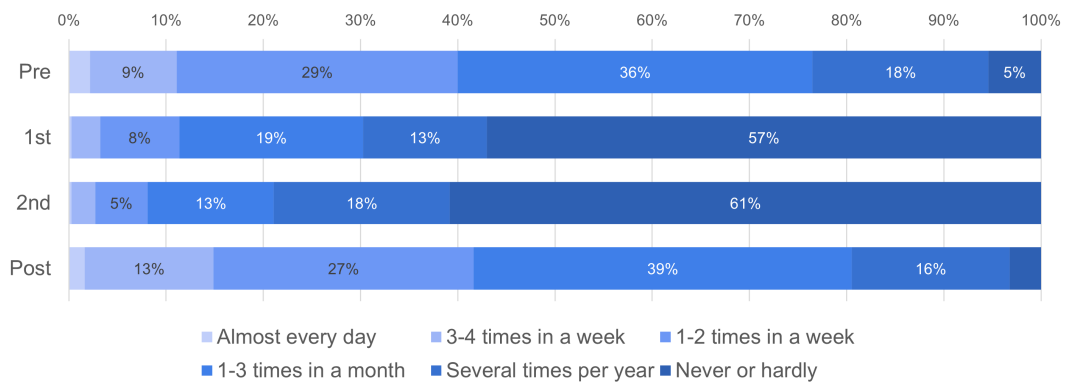


Figure 4.9: Share of frequency of engaging in indoors activities in each studied period

Private indoors activities also see a radical decline in frequency (figure 4.10). The figure is however very similar between the pre- and post-Covid periods.

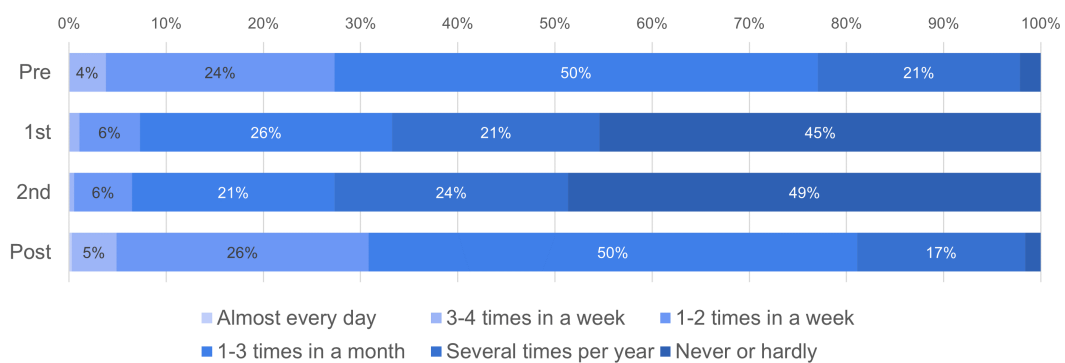


Figure 4.10: Share of frequency of engaging in private indoors activities in each studied period

The frequency of engaging in online activities sees quite the rise (figure 4.11). With social distancing enacted, and the ease of engaging in such activities this increase is expected.

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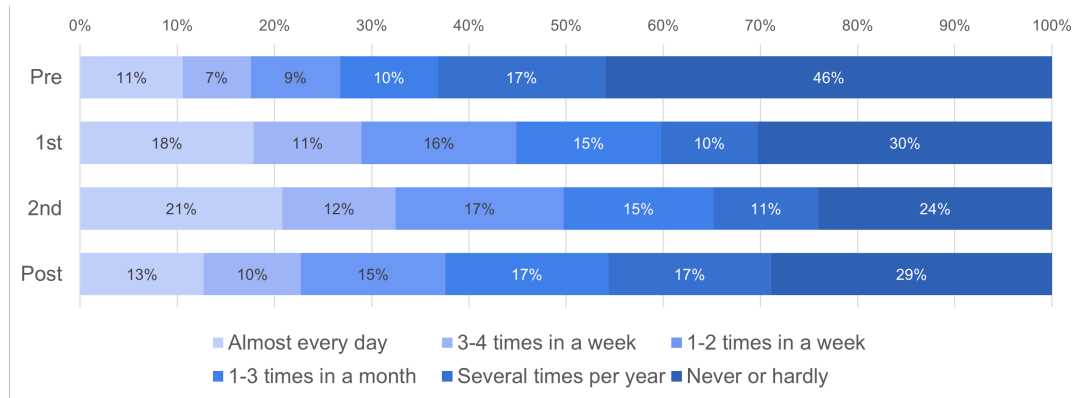
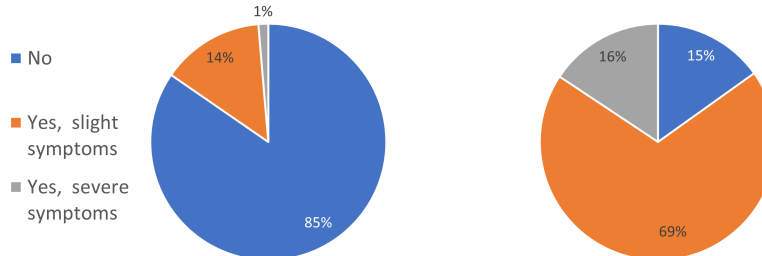


Figure 4.11: Share of frequency of engaging in online activities in each studied period

4.1.5 Risk perception and Covid impact

The amount of respondents who has been infected by Covid reaches 15% (figure 4.12a) of "yes", meanwhile that number reaches 85% when asked if the respondents know friends or acquaintances who have been infected 4.12b. These figures properly reflect the available Covid numbers, which says about 10% of people have been infected at some point. There is of course an estimated number of unknown cases which would make up some of the difference.



(a) Have you tested positive for COVID-19? **(b)** Have your friends or close acquaintance been infected by COVID-19?

Figure 4.12: Share of respondents infected by Covid (a) and relations with effected (b)

It is surprising that more than 35% answer that their financial situation has been better/much better during the pandemic (figure 4.13). This change is probably due to a decrease in expenses, rather than an increase in working hours/wages.

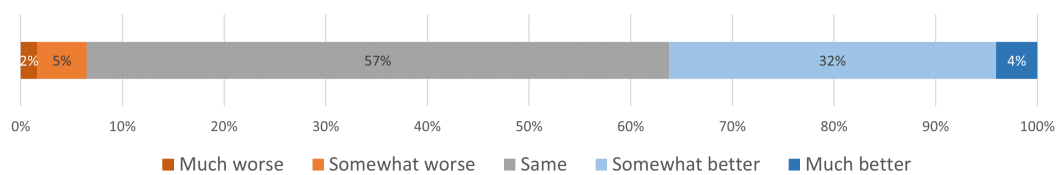


Figure 4.13: Share of change in financial situation due to Covid

As expected, the change in well-being is worse in the pandemic period, with more than 50% reporting that their well-being is "somewhat" or "much worse" in the pandemic period (figure 4.14).

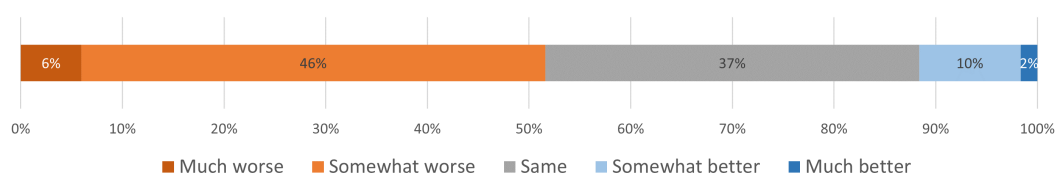


Figure 4.14: Share of change in well-being due to Covid

Physical activities have also taken a toll in the pandemic period with more than 50% engaging in somewhat/much less of them (figure 4.15). The level of people physical health might have been the bargain to some extent decrease the spread. With less engaging in all activities, of course exercise and going to the gym will be lacking.

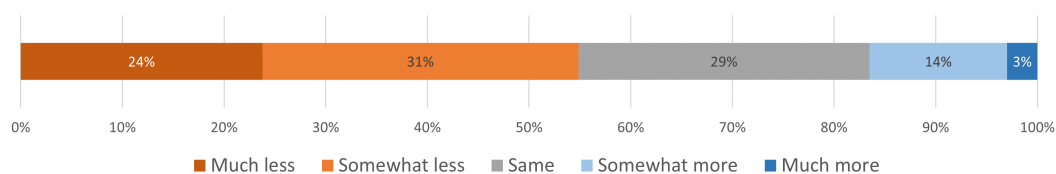


Figure 4.15: Share of change in physical activities due to Covid

As for the level of agreement with the statements that was posed in the survey, there is a large discrepancy in the controversial idea of wearing masks (figure 4.16). The Swedish approach to mask wearing took a while to kick in, it was not until 2021 it started to be recommended by public health authorities, which could explain the disperse in answers. The fear of being affected is similarly dispersed. As for the later questions, there is almost unison agreement about the difficulty in treatment, the control of the spread, and health impact if infected.

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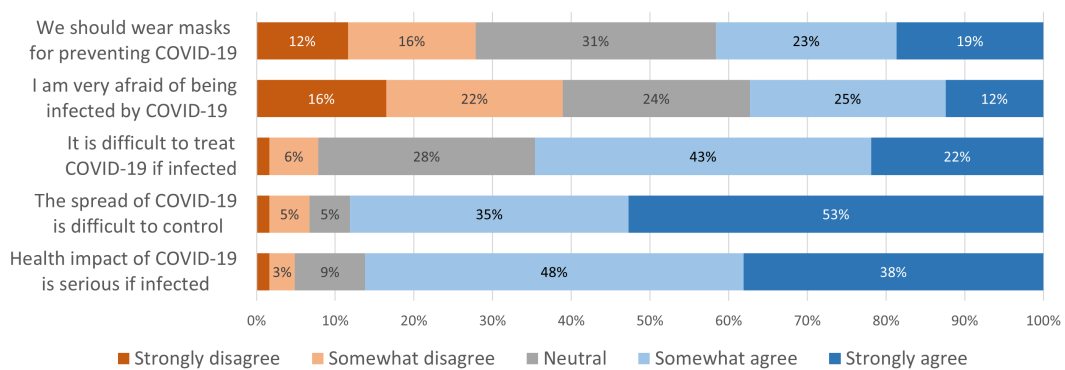


Figure 4.16: Share of agreement of statements regarding the pandemic

The perception of risk in different environment is overall high. For physical meetings, its more than 50% who thinks its high/very high risk (figure 4.17). This figure is above 70% for public transit. For public locations 52% say they think its high-/very high risk, and in the workplace the lowest number is recorded which is 39%. When it comes to workplace, it is very dependent on what type of workplace you work in. We expect this figure to rise amongst essential workers who cannot choose to stay at home.

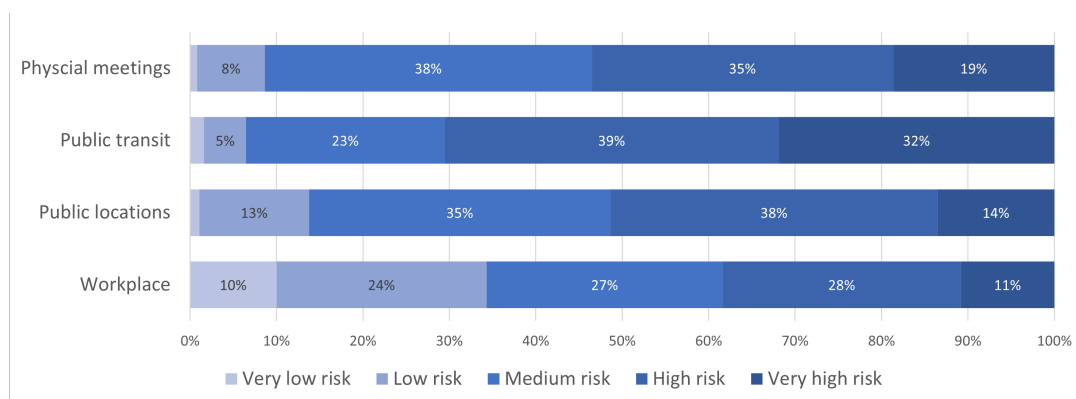


Figure 4.17: Share of risk perception in different situations

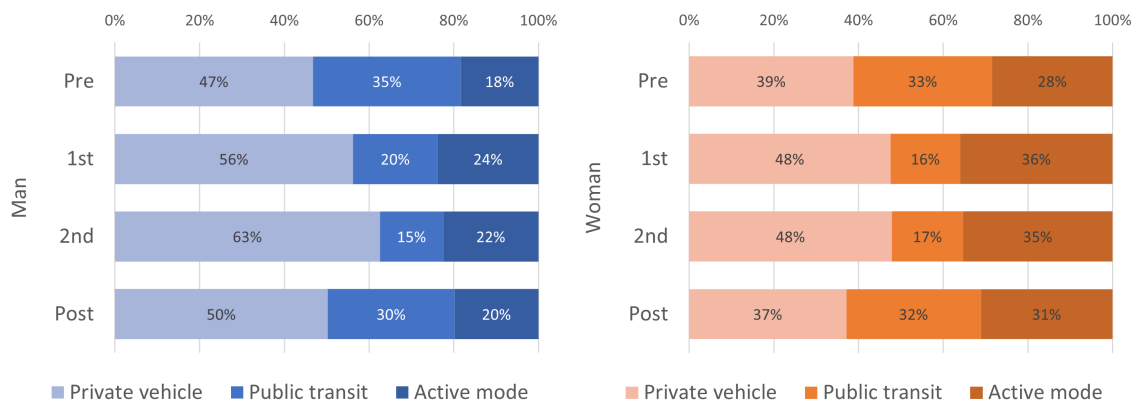
With 15% having been infected by Covid, and 85% reporting that they know someone who has been infected, the overwhelming agreement about the complications that Covid imposes on people as well as its extensive spread is not surprising. The impact of people's health, physical and mentally, has taken a toll during the pandemic period.

4.2 The disparities of the impacts from the pandemic on different groups

This section presents the results from the socioeconomic analysis. Here the data has been divided into three socioeconomic categories, gender, income, and occupation for further analysis.

4.2.1 Gender

For mode choice between the genders, there is a small difference in use of public transit, with males more likely to use private vehicles, and women more spread in their use of all modes (figure 4.18). There is a similar shift in mode choice in the 1st pandemic period, however for women the shift in-between the pandemic periods are almost unchanged, but for males we see a further increase in private vehicle use. One note-worthy observation is that more males want to use private vehicle in the post-pandemic period, meanwhile fewer women report that for the same period compared to pre-pandemic figures. Women also use active modes in a larger capacity than males.



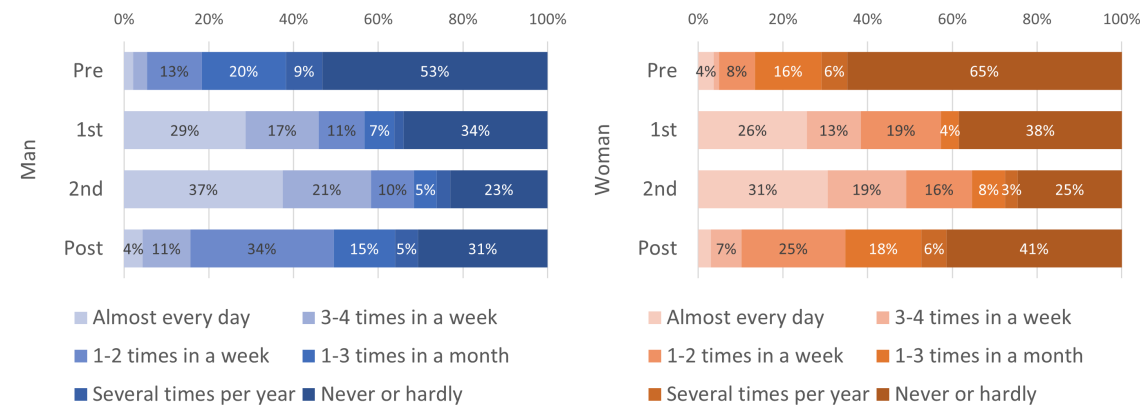
(a) Mode choice by men

(b) Mode choice by women

Figure 4.18: Share of mode choice by gender, men (a) and women (b)

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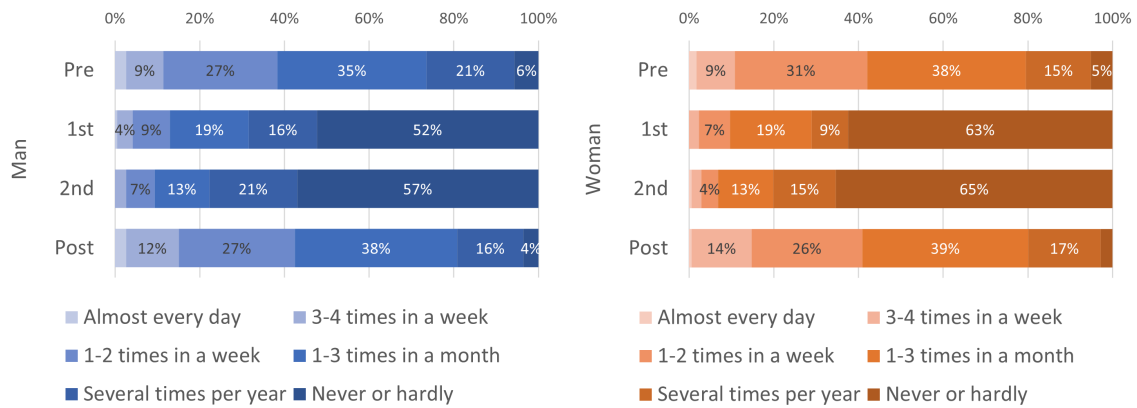
In the pre-pandemic period women had never or hardly worked from home to a larger extent than for men (65% vs 53%) (figure 4.19). This change then persists to some extent in the post-pandemic period with more men considering working from home on a weekly basis than women (49% for men vs 35% for women). This change might be due to difference in occupation, with women working more essential jobs, than men to some extent. In the pandemic period, the difference is more cohesive between the genders, and the difference is negligible.



(a) Frequency of working from home by men
(b) Frequency of working from home by women

Figure 4.19: Share of frequency of working from home between the genders, men (a) and women (b)

In the frequency of engaging in leisurely activities indoors, the figures are very similar between the genders (figure 4.20). Men report some higher frequency of engaging in the activity in the pandemic period, however. The pre- and post-periods are almost identical between the genders.



(a) Frequency of leisurely activities by males (b) Frequency of leisurely activities by females

Figure 4.20: Share of frequency of leisurely activities by gender, men (a) and women (b)

The change in well-being between the genders due to the pandemic is very negligible (figure 4.21). Men seems to edge out with a more positive response, but the difference is very small.

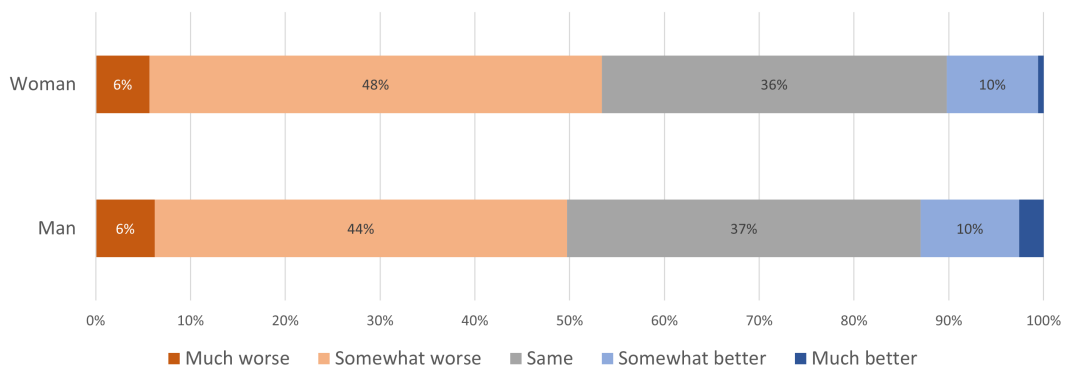


Figure 4.21: Change in well-being due to the pandemic

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For the financial situation men seems to have favoured in the pandemic (figure 4.22). More responses to "much better", "somewhat better", and fewer responses to "much worse" and "somewhat worse". Maybe this again comes down to the type of occupation men and women typically holds.

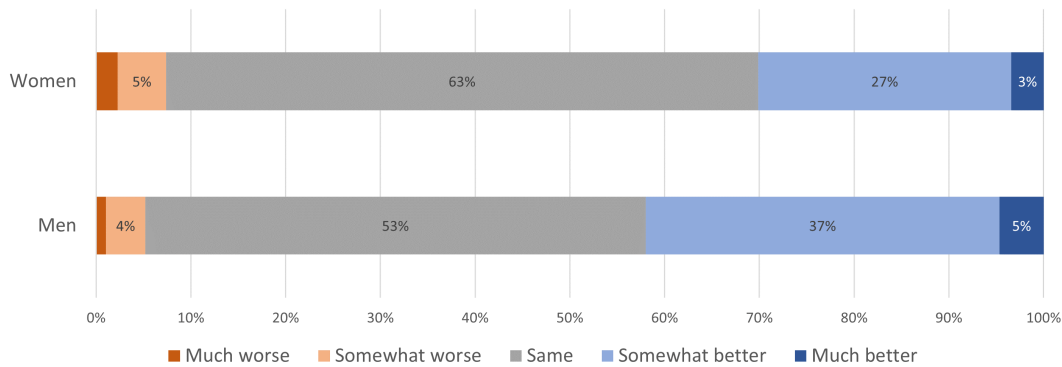
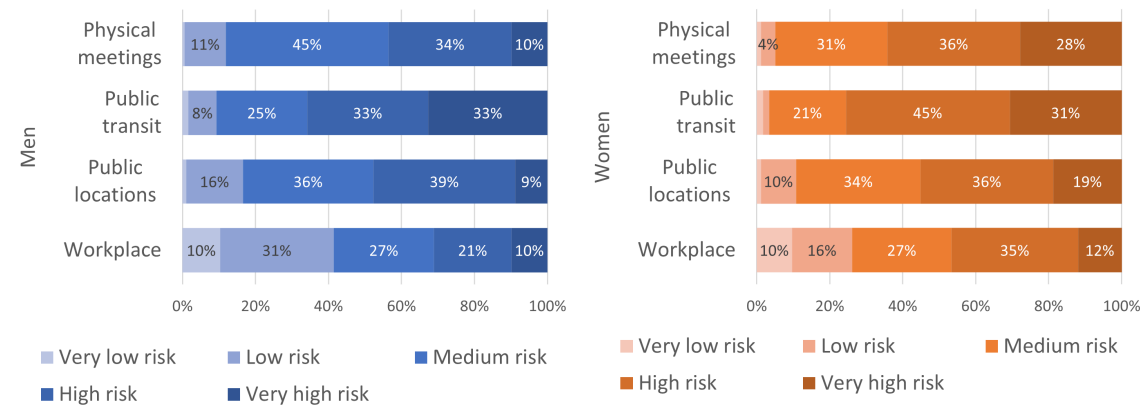


Figure 4.22: Change in financial situation due to the pandemic

Looking at the risk perception between the genders, women have higher across the different categories (4.23).



(a) Risk perception on certain activities by men **(b)** Risk perception on certain activities by women

Figure 4.23: Share of risk perception by men (a) and women (b)

There is a noticeable difference in almost every result between the genders, with men being a bit less restrictive in general.

4.2.2 Income

In the pre-pandemic period low income/poor only 17% use private vehicle, and almost half use public transit as their commute mode (figure 4.24). However, in the pandemic periods the decrease in public transit is noticeable, and is spread mostly to private vehicles, rather than the active modes. In the 2nd pandemic this is most apparent, where the change from the pre-pandemic period for private vehicles has almost double, meanwhile the active modes are almost unchanged. In the post-period the figure for private vehicles ends up at 25%. Investing in a private vehicle is costly, and for lower income earners the loss of selling might not be beneficial, which might display their continuing of using private vehicles even post-Covid.

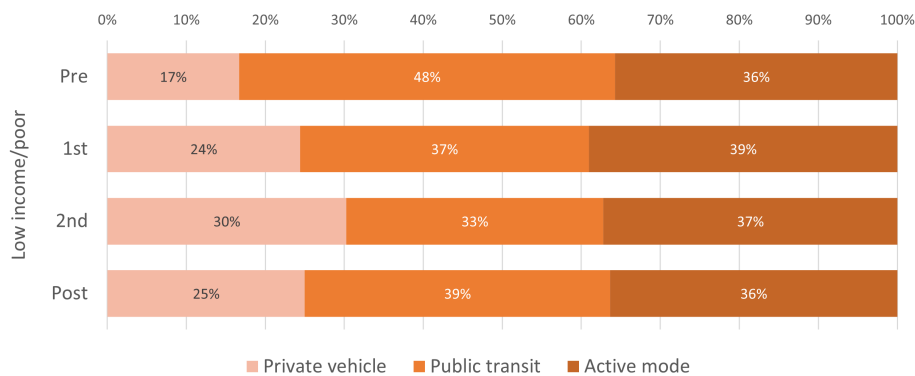


Figure 4.24: Low income mode choice change

For middle income respondents the pattern is similar, but the shift from public transit is more spread between private vehicle and active modes (figure 4.25). It is also noted that the lowest figure for public transit is noted for all income levels in the 2nd pandemic period at 13%. In the post-period the private vehicle value returns to its pre-period figure, meanwhile there is a small increase in active modes.

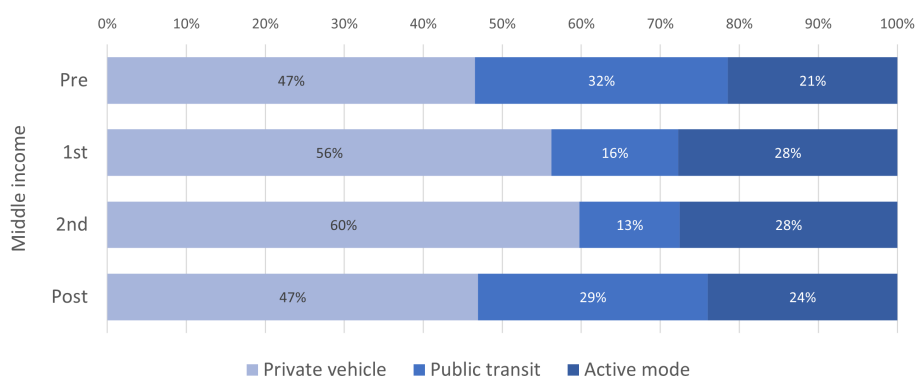


Figure 4.25: Middle income mode choice change

For high income earners, more than 50% say they use a private vehicle in the pre-pandemic period (figure 4.26). This figure increase in the pandemic periods, and peak at 68% in the 2nd period, the highest for all income levels. What is noteworthy is the increase in active modes between the pre- and 1st pandemic period, a

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jump from 11% to 25%. This figure decreases to 18%, which could be explained by the seasonal change between the periods.

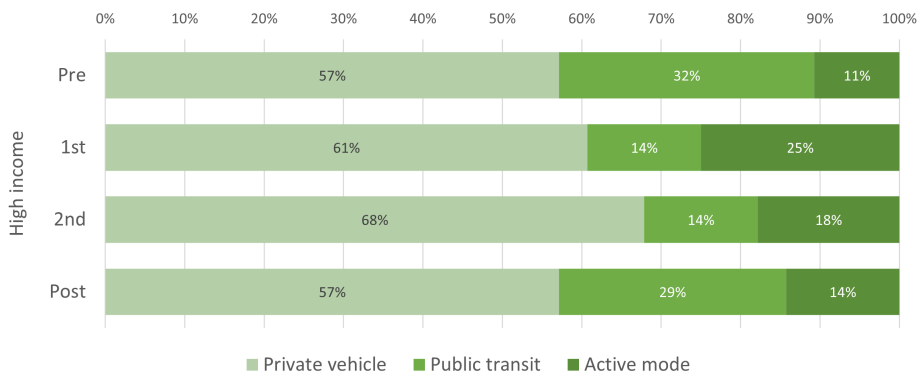


Figure 4.26: High income mode choice change

For low-income earners, more than half of the respondents say they "never or hardly" worked from home in the pandemic period (figure 4.27). However, there is a notable difference in increase of working from home daily (10% to 34%) and weekly (10% + 12% to 34% + 17% + 20%) between the pre- and 1st pandemic period.

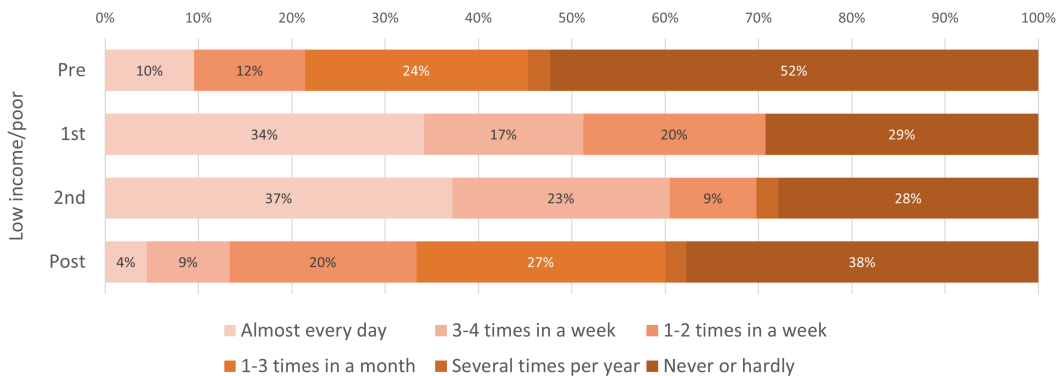


Figure 4.27: Low income working from home frequency

Middle income earners report the highest number of "never or hardly" working from home in the pre-pandemic period at 62% (figure 4.28). In the pandemic periods however, the frequency of working from home increases substantially. The post-pandemic figures is also more similar to the 1st pandemic period rather than the pre-period.

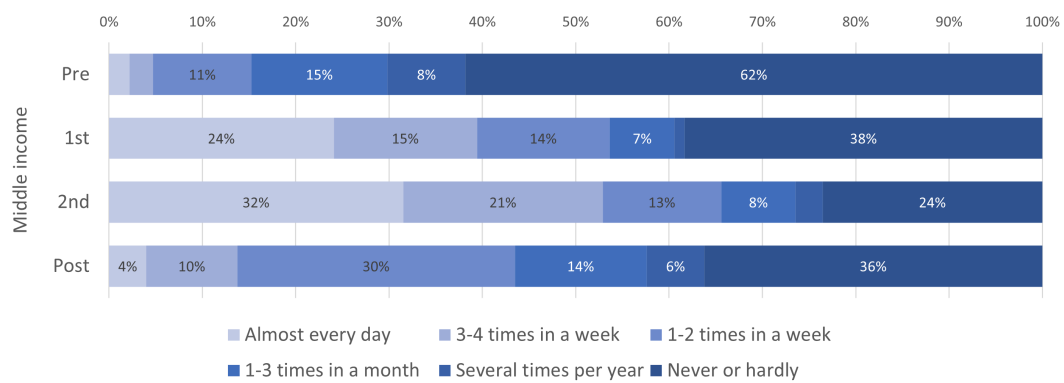


Figure 4.28: Middle income working from home frequency

High income earners report the lowest figure of "never or hardly" working from home in the pre-pandemic period (figure 4.29). They also report a staggering 43% of working from home "1-3 times per month", which might be due to the freedom higher income jobs earn to their working hours. They also report the lowest of "hardly or never" in the 2nd pandemic period, a figure that almost persists in the post-pandemic period at 21% which is the lowest by far between the income groups.

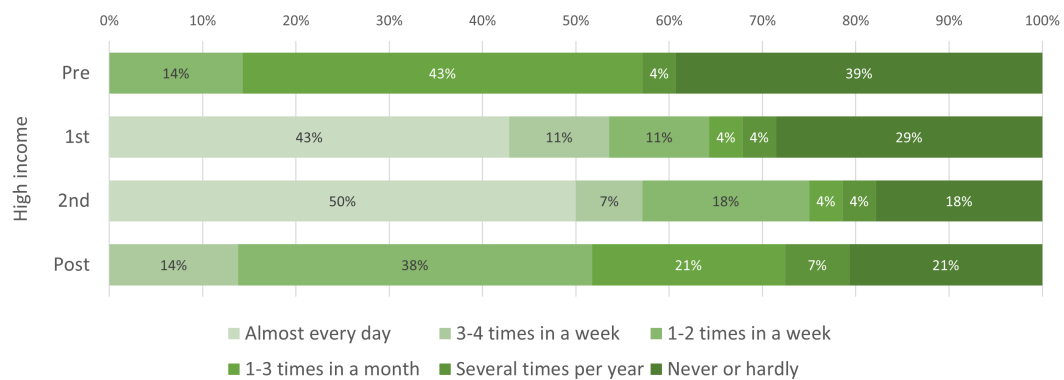


Figure 4.29: High income working from home frequency

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For low income/poor we see the smallest financial gain during the pandemic with only 24% reporting "somewhat better" (figure 4.30). They also report 16% of the "somewhat worse" and "Much worse", meanwhile middle- and high-income earners report 4% and 3% respectively. High income earners also report the most financial gain during the pandemic with 44% reporting that their financial situation has improved.

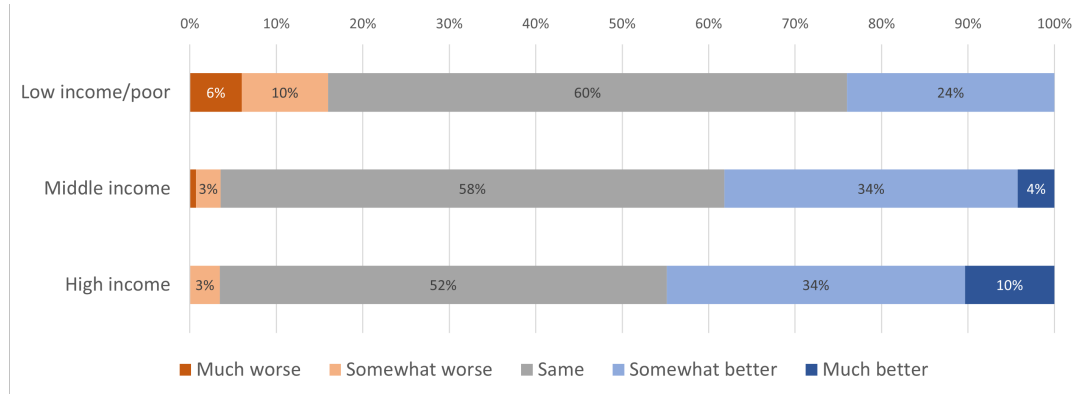


Figure 4.30: Change in financial situation based on income

Well-being also seems to have deteriorated the most for low income/poor earners (figure 4.31). More than 65% a worsening to their well-being during the pandemic, compared to 50% for middle income earners, and 38% for high income earners. Middle income earners report the highest increase in well-being for the better with 14%.

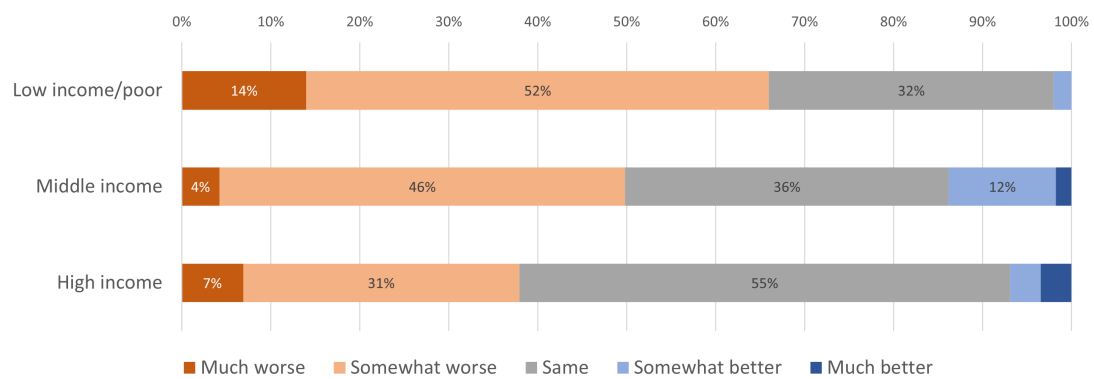
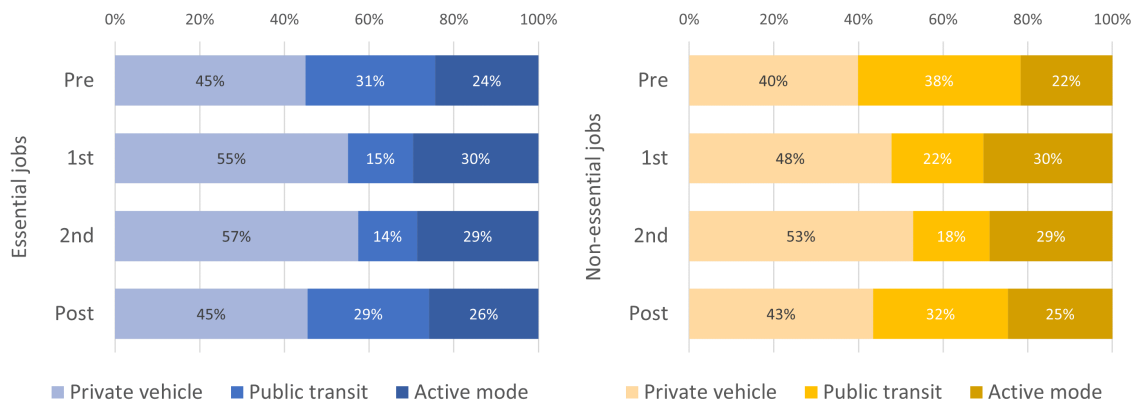


Figure 4.31: Change in well being based on income

The connection is apparent between the lack of financial gain during the pandemic and the deteriorating well-being of low income/poor earners. Also, fewer higher earners report a worsening to their well-being, but they report the largest financial gain. It is of course not the full story, since some low income/poor people report some financial gain during the pandemic period, however income security is a factor to well-being, maybe more impactful for lower income earners.

4.2.3 Occupation

Overall, essential workers use public transit less than non-essential workers throughout the observed periods (figure 4.32). The biggest discrepancy is in the pre- and 1st pandemic period, where the gap is 7%, which is not huge. Both groups see a decline in public transit usage, with that number almost recovering in the post pandemic period for essential workers (-2%). Meanwhile for non-essential workers, there is a bigger change between the public transport usage in the pre- and post-pandemic period (-6%), spreading even between private vehicle and active modes (+3% each).

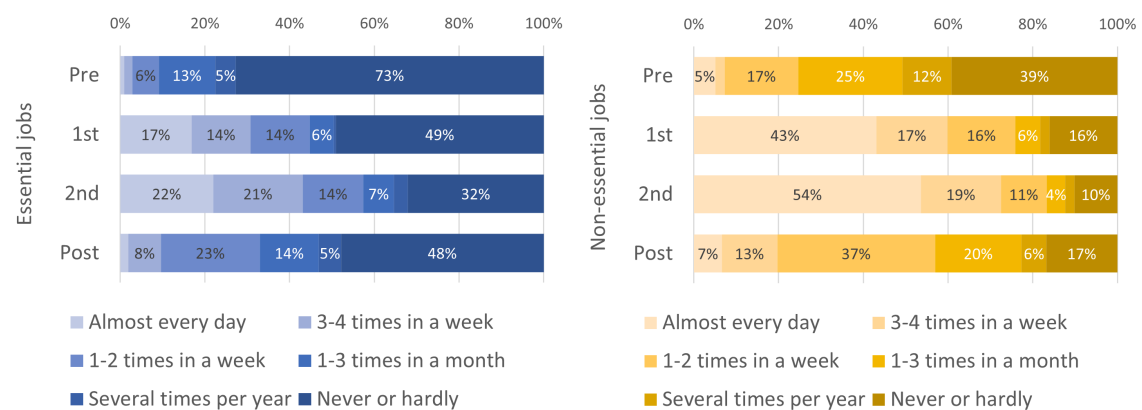


(a) Mode choice by essential workers

(b) Mode choice by non-essential workers

Figure 4.32: Share of mode choice by essential workers (a) and non-essential workers (b)

The results between essential and non-essential workers when it comes to working from home frequency is much more disperse than for mode choice (figure 4.33). Even in the before period, the difference between the workers who have "Never or hardly" worked from home reaches 34%. Non-essential workers reach almost a quarter of respondents that work from home on a weekly basis in the before period (24%). Only 9% for essential workers in the same period. Both sets of workers show a substantial increase in frequency of working from home in the pandemic, however. In the 2nd period a majority of essential workers report that they work from home, at least weekly (57%), meanwhile for non-essential workers that number amounts to 83%. It is also noteworthy that a majority of non-essential workers report that they work from home "Almost every day" 43% in the 1st pandemic period, and 54% in the 2nd. In the post-pandemic period essential workers report that a third of workers will work from home weekly, an increase from 9% before the pandemic. Meanwhile a majority of non-essential workers (57%) in the same period, an increase from 25%.



(a) Working from home frequency by essential workers **(b)** Working from home frequency by non-essential workers

Figure 4.33: Share of Working from home frequency by essential workers (a) and non-essential workers (b)

From the change in well-being we can see that non-essential workers have been slightly worse off due to the pandemic (figure 4.34). More than half of non-essential workers report that their well-being has worsened due to the pandemic (59%), compared to 44% of essential workers. Slightly more essential workers report a betterment to their well-being, 13%, that figure is 10% for non-essential workers.

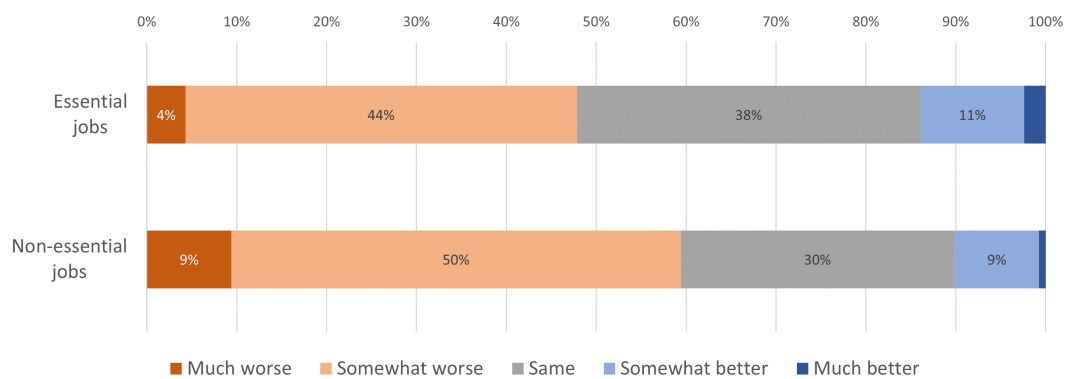


Figure 4.34: Change in well-being by essential/non-essential workers due to the pandemic

For the financial situation between the occupations, the discrepancy is even smaller (figure 4.35). Here, the figure is almost identical for a worsening, meanwhile non-essential workers have seen a slight larger gain financial (43%) compared to essential workers (32%).

4. Results

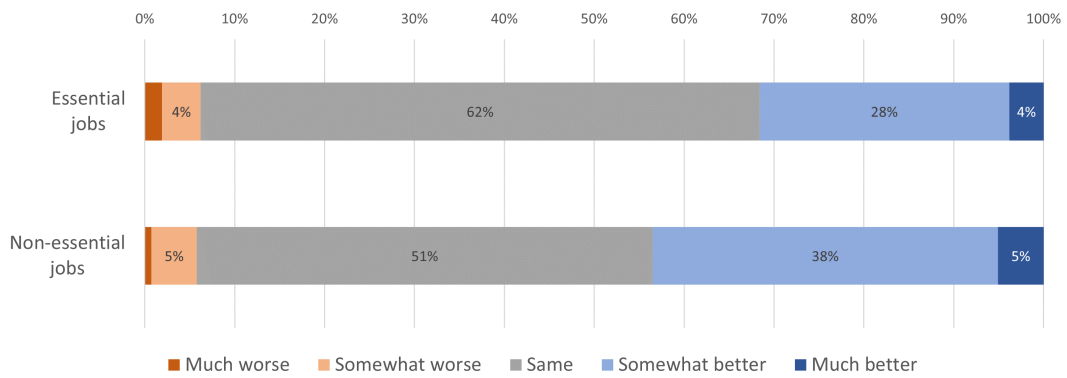


Figure 4.35: Change in financial situation by essential/non-essential workers due to the pandemic

The risk perception between the occupations is quite dispersed (figure 4.36). Both groups consider physical meetings, public-transit, and public locations similarly, with very few answers perceiving it lower than medium risk. Both consider public-transit high/very high risk, with more than 70% of the answers for both groups. In their workplace, essential workers consider it more risky, with 45% consider it being high/very high risk. For non-essential workers that number is 29%.

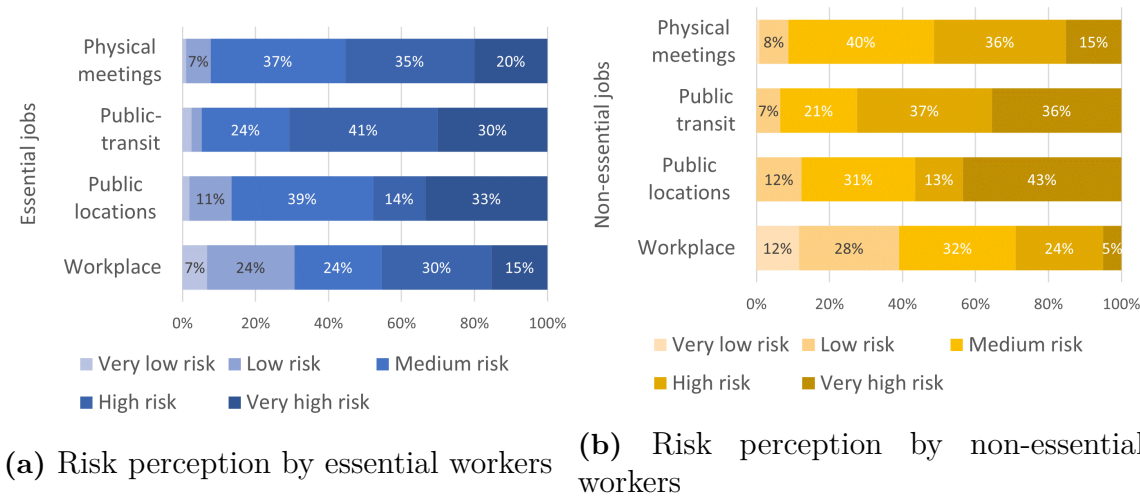


Figure 4.36: Share of risk perception by essential workers (a) and non-essential workers (b)

5

Discussion

This chapter will discuss each of the objectives in the thesis. It will also bring forward potential issues with the survey, what could have been done differently, ways to improve the method, and discuss the influence of certain factors. Overall themes will be drawn to from the objectives to better understand the impacts and will later then serve as the basis for drawing conclusions.

5.1 Develop a tailored survey to reveal to what extent people adjusted their daily travel behaviour during the pandemic

Overall, the survey performed well. The target amount of responses was set to 300, so increasing that amount to roughly 370 was positive. The vast majority of the feedback was positive, expressing interest in the thesis and its result later on. Some complications arose during the distribution period, however. People were struggling with filling in the form. These issues ranged from issues with the formatting of questions, to the questions themselves being non-sufficient for them to answer properly. However, these people were in the great minority, and even if their input was important, would not have change the outcome of the survey as a whole.

One question that was not interpreted as wished was the question "how long was your commuting time?" which respondents seem to not have understood the time frame of. The answers ranged from 5 to 600 minutes which we then believed included daily commuting time as well as weekly. The information of time commuting could have been used to understand how distance to workplace impacted travel changes due to Covid. It would have been useful to see how commuting time or distance would impact change in behaviour due to risk of infection. It is also a curious case how the question about financial situation changed during Covid, where 35% responded "somewhat better" and "much better". The question does not specify whether this implicates more income or just more money left at the end of the month. With less engagement, change in routines, leisurely activities declining, the financial situation have probably gone towards the better for most people. So, maybe, some of the respondents who answered "same" did not take this into account.

One glaring disadvantage with surveys, especially online, is that the information you are able to gather is very limited. There are many factors at play when questioning

someone's behaviour, most apparent when asking agreement with statements. People's answers when it comes to risk perception and Covid knowledge depends on a lot of external factors which are hard to obtain in a survey. Here, some more complex, and mature modelling scheme would have ciphered through the results more delicately. Being able to connect more dots in the socioeconomic information would have created a greater opportunity to understand why certain groups responded the way they did. This sort of analysis was scrapped due to time restraints and quite a steep learning curve to perform. Just having the results represent the whole population, with some small divisions, leaves a lot to be desired when trying to draw concrete conclusions.

One unutilized topic of information that was gathered by the survey was postal codes. This could have served as a further tool to analyze the results looking at differences between people living in rural and urban areas. Public transit availability, distance to work/grocery store, difference in leisurely activities, all differ greatly between rural and urban areas. These differences greatly impact how willing you are to change behaviour due to a pandemic. However, due to badly posed questions and time issues, this could not be pursued. The questions should have not only included postal code, but place-name as well for easier sorting.

5.2 Investigate to what extent mode choice, activity and travel choice for different purposes has changed in different periods

From the results it becomes apparent that Covid has caused behavioural changes when it comes to both mode choices and frequency of engagement in various activities, as well as the personal health and wealth of people's lives. Regarding mode choice, there is to a great extent a decrease in usage when it comes to public transit. Universally across the different usages, commuting, shopping, and leisure, public transit experiences a decline.

Overall, the frequency of engaging in activities has to a great extent declined, except for working from home and online activities which has seen an expected increase. With various recommendations and guidelines put in place to halt the impact of the virus, such as a cap on people at gatherings, social distancing, and restrictions to travel, it is no wonder that people's activity level has decreased. The point raised in the literature study, regarding that people found a way to live with the pandemic, facilitating a decrease in restrictive behaviour throughout the pandemic is not as apparent in our results. The results for leisurely activities are almost exclusively reduced in frequency throughout the pandemic period.

Generally, the results show a certain shift between the first and second pandemic period across all the results. For mode choices, this often meant further decrease in usage, for working from home it saw an increase in frequency, meanwhile for shopping and leisure it saw a decrease in frequency. This is in line with the restrictions

that are being put in place and tightened as the pandemic progresses. With the knowledge from the survey, that in most cases public transit has declined, engaging in activities has declined, the environmental impact from traffic is also assumed to have declined. To what extent is difficult to conclude. The survey did not measure the respondent time nor length travelling in the different periods so quantifying a decrease is not possible. From the literature study it become apparent that change in behaviour have decreased emissions, this due to a decrease in road traffic. The results point towards a slight shift in mode choice however, with personal vehicles being favoured. However, with the decrease frequency in engaging in activities, how often each mode choice is used is also decreased, which would point toward a decrease in emissions overall.

5.3 Investigate the relationship between the change in behaviour and risk perception. Also, effects on the perceived well-being, financial and physical health

The risk perception is to a great extent very high. In three of the categories, physical meetings, public transit, and public locations, the majority of respondents regard it as high/very high risk. This coupled with the overwhelming agreement with statements like "The spread of COVID-19 is difficult to control" and "Health impact of COVID-19 is serious" it is no surprise. This is later reflected in the results for both mode choice and the frequency of engaging in various activities.

As previously mentioned, public transit has seen a decrease to a great extent in the pandemic across the various scenarios. For future pandemics, there might be incentives to shrink this decline. Increasing the frequency of departures to lower congestion, demanding masks, and a greater population working from home, might lower the perceived risk associated with public transit.

People generally express a high-risk perception to public locations and physical meetings which probably results in the decline of engaging in activities where this occurs. This is where a majority of people connect and socialize. We see in the results that more than half have expressed a decline in both well-being and physical activities. This will have an effect on the mental health of people, which is important to be vary of. Finding solutions to better socialize during a pandemic and being pungent but fair in your restrictions is one aspect of this. There is more research required to more accurately understanding where and how this virus spreads, and what restrictions are most effective. With this knowledge, in the future, there should be more sound restrictions, hopefully to the betterment of people's health overall.

5.4 Investigates the disparities in effects of the pandemic on different groups

For the mode choices between the genders, men are more likely to use private vehicle and public transit, meanwhile women use active modes to a larger extent. This notion is backed by the information put forward in the literature study. There is still a noticeable decline in public transit usage, for both genders. Between the pandemic periods however, the decline in public transport usage is furthered for men. For women, their mode choice behaviour is almost identical, not conscribing to the notion that behaviour would be further restrictive in the second pandemic period. The cause of the discrepancy in mode choice is difficult to pinpoint, however there is underlying societal differences which determine this.

Generally, women seem to be more restrictive to engage in activities during the pandemic periods, as well as working from home. As the results show, women show a higher perception of risk across the different categories. This could explain their more restrictive behaviour with the decline in public transit and the frequency of engaging in various activities.

Between men and women regarding their well-being there is a very small discrepancy, however, men have seen a small betterment to their financial situation. We also see that low income/poor earners are quite worse off financially than middle/high income earners. It is similar to occupation where essential jobs have not seen a betterment to its financial situation to the same extent as non-essential workers. Non-essential workers have also taken a worse toll to their well-being during the pandemic. They have however seen a bigger improvement to their financial situation than essential workers. It is important to minimize these impacts, and decrease the gaps between the different socioeconomic groups, especially during a very uncertain time like a pandemic.

Due to lack of enough respondents for certain categories, mainly occupation, the data did not seem sufficient to analyze specific sectors. This could have furthered the understanding of peoples travel behaviour. There is a lot left to be desired when it concerns the division of essential and non-essential jobs. Having the respondents more accurately specify if their jobs are in the category of being essential or not would have cleared some of the thesis limitations. If the division of respondents into each category of occupation would have been done correctly, there should be an even greater disperse between the answer. Especially in the working from home answers, since, for example, teachers are not specified which grades they teach, and lower school classes have not had home schooling to the same extent as higher learning teachers. Since Sweden's approach was more open than other countries, this factor might have been small, but as the data suggest most people who could work from home started to during the pandemic to some degree. One idea in the beginning of the project was to only question certain socioeconomic group or professions, but since this would limit the scope furthered it did not seem as valuable.

5.5 Make a prediction to what extent these behaviours will continue after the pandemic, and the potential impact on emissions

With vaccinations in progression, the aftermath of the pandemic is within sight. The results indicate that most behaviours return to their pre-pandemic levels, but often to a lesser extent. For example, working from home or ordering groceries online, we see that the frequency increases compared to the pre-period. A lot of the established behaviours during the pandemic might be hard to just give up on when the pandemic is over.

In the post-pandemic world, it is important that we learn from our pandemic behaviour and continue the positive changes even in the post-pandemic world. There is a strong case to be made for continuing to work from home. Maybe not to the extreme extent as the second pandemic period, but the results show that the frequency of working from home will increase compared to the before period. This could have direct implications on emission and congestion, which are urgent issues of today. There is also the issue of car usage, which saw an increase in usage during the pandemic. This change however seemed to not persist in the post-period to the same extent as working from home.

In some regard there is an observed rebound effect, with respondents showing to some extent more interest in engaging in certain shopping and leisure activities after the pandemic compared to before. Eating at restaurant and indoors activities (both public and private) exhibit this change. It might be that, after a very restricted pandemic year, people are keen on enjoying themselves more. Hopefully, this increases the well-being and physical activities amongst respondents who reported a substantial decline due to the pandemic. Other, more societal impacts like economy growth could also come from this. It is important in the future to regard these changes, where people's everyday life is limited, to not suffer the same consequences when it comes to well-being and physical activities.

There must be incentives for stakeholders to facilitate these issues. Companies could see financial benefit in allocating less office space for their workers, transit companies should be more prepared with solutions to not see the same decrease in usage, and city planners should work on solutions for the eventual increase in private vehicles and active modes.

5.6 Limitations

The thesis scope was limited to the observation of Sweden. The reason for this was to more accurately study a country's change in behaviour, where restrictions have been limited to the confinement of that country. The behaviour change was observed through a survey. Change is then observed through respondents answers to different queries in four different time periods. Travel is limited to on-land travel,

5. Discussion

so no questions about air-travel was posed. Results was be derived from excel using Pivot tables. Any complex analysis methods like regression model was not used due to time restrictions. No quantified values of kilometers driven or emissions was derived.

6

Conclusion

The aim of this thesis was to enlighten the influences of the Covid pandemic on daily mobility patterns. Potential behaviour changes in travel were gathered through a successful survey. Overall, there is a noticeable change in most of the observed behaviours between the pre-pandemic period in comparison to the two observed pandemic periods. There is an obvious decline in public transit users, with an overwhelming agreement with it being a risky environment. For both commuting and leisurely activities the engagement with public transit is cut by half in the second pandemic period. However, for groups like low-income earners, the decline is to some extent less potent. There has been an almost unison increase in working from home, between all the socioeconomic groups, with some of it persisting after the pandemic. All this change is reflected in the overwhelming risk perception when it comes to things like public transit, physical meetings, and public locations. What long lasting effects these changes will have is difficult to tell. From the survey however it becomes apparent that well-being has taken a toll during the pandemic as well, leaving more than half of the respondents worse off than before. It is also difficult to quantify any environmental effects, but with the restrictions and changes in behaviour, both congestion and emissions should have seen a decline due to a decrease in frequency in engaging in activities. The analysis in this thesis is only sufficient to observe the change, with limited reasons to why the change occurs. Further investigations should include some sort of regression model, to understand and predict the behavioural change more accurately.

In conclusion, the pandemic brought with it certain shifts in our travel behaviour. In the entirety of the sample pool, there is not one individual who had not changed their behaviour at all. However, there is no evidence to support any paramount shift in our behaviour, but hopefully the implementation of restrictions will be more braced in the future.

7

Future work

To further achieve this thesis aim, a more sophisticated model should be used to derive the results. Using a regression type model would have the potential of better understanding what change occurred, and why it occurred. It would be at an advantage to use such a model when trying to depict change between modes, activities, groups etc.

Using online surveys leaves a lot to be desired. It could have been helpful to add some qualitative data, through interviews, and under more familiar circumstances perform them face to face. However this was limited due to Covid restrictions.

Putting more emphasis on delivering quantified values for decreased travel and emissions was not pursued in this thesis. The survey was designed to look at change in behaviour, rather than hard numbers on kilometers driven. Such research could be paired with the research in this thesis, to further sustain valuable conclusions. Overall, there is coming out more and more data and research similar to this topic, which will all be beneficiary to future work.

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A

Appendix 1

A.1 Survey

Travel behavior changes due to COVID-19 pandemic

Dear Sir and Madam:

The COVID-19 pandemic has changed many aspects of our life. We invite you to participate in a research study for understanding the travel behavior changes due to COVID-19. The results will support university research, help communities recover faster and become more resilient to the next adverse event.

Your participation in this study is voluntary, but very important. It is important that you answer truthfully and all the questions, which are crucial for the right reflections.

The survey is totally anonymous and free from privacy. The survey takes about 10~15 minutes to finish.

Thank you in advance for your participation and supports. If you have any questions, please contact adam.gustafsson@hotmail.com.

* Required

Daily behavior before the pandemic (before February 2020)

Please recall the daily behavior before the pandemic (before February 2020) and answer the following questions according to your real experience.

1. Before the COVID-19 pandemic (before February 2020), what was your employment status? *

Mark only one oval.

- ☐ Employed full-time *Skip to question 2*
- ☐ Employed part-time *Skip to question 2*
- ☐ College undergraduate, Master, or PhD student *Skip to question 3*
- ☐ Not employed but looking for work *Skip to question 3*
- ☐ Not employed and not looking for work *Skip to question 7*
- ☐ Retired *Skip to question 7*

Daily behavior before the pandemic (before February 2020)

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Travel behavior changes due to COVID-19 pandemic

2. What did your primary job belong to, before the pandemic (before February 2020)? *

*

Mark only one oval.

- ☐ First respondents (e.g., police and firefighter)
- ☐ Healthcare (e.g., doctor, nurses, and paramedic)
- ☐ Services (e.g., transit company, grocery retailers, shops, and restaurants)
- ☐ Public organizations or authority
- ☐ Teaching and education
- ☐ Industry employee (e.g., automotive, IT, manufacture industry)
- ☐ Construction and maintenance (e.g., plumber, building worker, gardener)
- ☐ Managment, consulting, finance
- ☐ Other: _____

Daily behavior before the
pandemic (before
February 2020)

Please recall the daily behavior before pandemic (before February 2020) and answer the following questions according to your real experience.

3. Before the pandemic (before February 2020), how many days did you work/study in a week? *

Mark only one oval.

- ☐ 0
- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ More than 5

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Travel behavior changes due to COVID-19 pandemic

4. Before the pandemic (before February 2020), how often did you work/study from home/telecommuting? *

Mark only one oval.

- ☐ Never or hardly
- ☐ Several times per year
- ☐ 1~3 times in a month
- ☐ 1~2 times in a week
- ☐ 3~4 times in a week
- ☐ Almost every day

5. Before the pandemic (before February 2020), what transport mode did you mainly use for commuting trips (to and from workplace)? *

Mark only one oval.

- ☐ Private car
- ☐ Public transport (bus, tram, ferry)
- ☐ Walking
- ☐ Private bicycles/e-scooter
- ☐ Shared public bicycles/e-scooter
- ☐ Private motorcycle
- ☐ Taxi or Ride-hailing (e.g., Uber)

6. Before the pandemic (before February 2020), how long was your commuting time? Answer in digits. (Minutes) *

Daily behavior before the pandemic (before February 2020)

Please recall the daily behavior before pandemic (before February 2020) and answer the following questions according to your real experience.

<https://docs.google.com/forms/d/1np4ZwoaqVX2qwg2RT5CZgw4y7zx8fNvm5hPBqYWoaw/edit>

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5/13/2021

Travel behavior changes due to COVID-19 pandemic

7. Before the pandemic (before February 2020), how often did you do the following shopping/dining activities? *

Mark only one oval per row.

	Never or hardly	Several times per year	1~3 times per month	1~2 times a week	3~4 times a week	Almost every day
Go shopping for household supplies (e.g., food and grocery)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Have meals at a restaurant or shop	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Order food delivery from restaurants or shops	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Online shopping for daily supplies (e.g., food, grocery and clothing)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

8. Before the pandemic (before February 2020), what transport mode did you mainly use for shopping trips? *

Mark only one oval.

- ☐ Private cars
☐ Public transport (bus, tram, ferry)
☐ Walking
☐ Private bicycles/e-scooter
☐ Shared bicycles/e-scooter
☐ Private motorcycle
☐ Taxi or Ride-hailing (e.g., Uber)

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Travel behavior changes due to COVID-19 pandemic

9. Before the pandemic (before February 2020), how often did you do the following social/leisure/recreational activities? *

Mark only one oval per row.

	Never or hardly	Several times per year	1~3 times per month	1~2 times a week	3~4 times a week	Almost every day
Activities at public locations (e.g., bars, cinema and shopping malls)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Activities at private locations such as home, friends'/relatives home	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Virtual or online activities (e.g., e-game, video and activities)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

10. Before the pandemic (before February 2020), what transport mode did you mainly use for leisure/social trips ? *

Mark only one oval.

- ☐ Private cars
- ☐ Public transport (bus, tram, ferry)
- ☐ Walking
- ☐ Private bicycles/e-scooter
- ☐ Shared bicycles/e-scooter
- ☐ Private motorcycle
- ☐ Taxi or Ride-hailing (e.g., Uber)

Daily behavior during the first wave of the pandemic (from February 2020 to July 2020)

Please recall the daily behavior during the first wave of the pandemic (from February 2020 to July 2020) and answer the following questions according to your real experience.

<https://docs.google.com/forms/d/1np4ZwoaqVX2qwg2RT5CZgw4y7zx8fNm5hPBqYWL0aw/edit>

5/24

5/13/2021

Travel behavior changes due to COVID-19 pandemic

11. During the first wave of the pandemic (from February 2020 to July 2020), what was your employment status? *

Mark only one oval.

- ☐ Employed full-time
- ☐ Employed part-time
- ☐ Not employed but looking for work
- ☐ Retired *Skip to question 15*
- ☐ Layoff with pay
- ☐ Layoff without pay
- ☐ College undergraduate, Master, or PhD student
- ☐ Not employed and not looking for work *Skip to question 15*

Daily behavior during the first wave of the pandemic (from February 2020 to July 2020)

Please recall the daily behavior during the first wave of the pandemic (from February 2020 to July 2020) and answer the following questions according to your real experience.

12. During the first wave of the pandemic (from February 2020 to July 2020), how many days did you have to work/study in a week? *

Mark only one oval.

- ☐ 0
- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ More than 5

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Travel behavior changes due to COVID-19 pandemic

13. During the first wave of the pandemic (from February 2020 to July 2020), how often did you work/study from home/telecommuting? *

Mark only one oval.

- ☐ Never or hardly
- ☐ Several times per year
- ☐ 1~3 times per month
- ☐ 1~2 times a week
- ☐ 3~4 times a week
- ☐ Almost every day

14. During the first wave of the pandemic (from February 2020 to July 2020), what transport mode did you mainly use for commuting trips (to and from workplace)? *

Mark only one oval.

- ☐ Private cars
- ☐ Public transport (bus, tram, ferry)
- ☐ Walking
- ☐ Private bicycles/scooter
- ☐ Shared bicycles/scooter
- ☐ Private motorcycle
- ☐ Taxi or Ride-hailing (e.g., Uber)

Daily behavior during the first wave of the pandemic (from February 2020 to July 2020)

Please recall the daily behavior during the first wave of the pandemic (from February 2020 to July 2020) and answer the following questions according to your real experience.

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Travel behavior changes due to COVID-19 pandemic

15. During the first wave of the pandemic (from February 2020 to July 2020), how often did you do the following shopping/dinning activities? *

Mark only one oval per row.

	Never or hardly	Several times per year	1~3 times per month	1~2 times a week	3~4 times a week	Almost every day
Go shopping for household supplies (e.g., food and grocery)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Have meals at a restaurant or shop	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Order food delivery from restaurants or shops	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Online shopping for daily supplies (e.g., food, grocery and clothing)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

16. During the first wave of the pandemic (from February 2020 to July 2020), what transport mode did you mainly use for shopping trips? *

Mark only one oval.

- ☐ Private cars
☐ Public transport (bus, tram, ferry)
☐ Walking
☐ Private bicycles/scooter
☐ Shared bicycles/scooter
☐ Private motorcycle
☐ Taxi or Ride-hailing (e.g., Uber)

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Travel behavior changes due to COVID-19 pandemic

17. During the first wave of the pandemic (from February 2020 to July 2020), how often did you do the following social/leisure/recreational activities? *

Mark only one oval per row.

	Never or hardly	Several times per year	1~3 times per month	1~2 times a week	3~4 times a week	Almost every day
Activities at public locations (e.g., bars, cinema and shopping malls)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Activities at private locations such as home, friends'/relatives home	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Virtual or online activities (e.g., e-game, video and activities)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

18. During the first wave of the pandemic (from February 2020 to July 2020), what transport mode did you mainly use for leisure/social trips? *

Mark only one oval.

- ☐ Private cars
- ☐ Public transport (bus, tram, ferry)
- ☐ Walking
- ☐ Private bicycles/scooter
- ☐ Shared bicycles/scooter
- ☐ Private motorcycle
- ☐ Taxi or Ride-hailing (e.g., Uber)

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Travel behavior changes due to COVID-19 pandemic

Daily behavior during the second wave of the pandemic (from August 2020 to now)

Please recall the daily behavior during the second wave of the pandemic (from August 2020 to now) and answer the following the questions according to your real experience.

19. During the second wave of the pandemic (from August 2020 to now), what is your employment status? *

Mark only one oval.

- ☐ Employed full-time
- ☐ Employed part-time
- ☐ Not employed but looking for work
- ☐ Retired *Skip to question 23*
- ☐ Layoff with pay
- ☐ Layoff without pay
- ☐ College undergraduate, Master, or PhD student
- ☐ Not employed and not looking for work *Skip to question 23*

Daily behavior during the second wave of the pandemic (from August 2020 to now)

Please recall the daily behavior during the second wave of the pandemic (from August 2020 to now) and answer the following the questions according to your real experience.

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Travel behavior changes due to COVID-19 pandemic

20. During the second wave of the pandemic (from August 2020 to now), how many days did you have to work/study in a week? *

Mark only one oval.

- ☐ 0
- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ More than 5

21. During the second wave of the pandemic (from August 2020 to now), how often did you work/study from home/telecommuting? *

Mark only one oval.

- ☐ Never or hardly
- ☐ Several times per year
- ☐ 1~3 times per month
- ☐ 1~2 times a week
- ☐ 3~4 times a week
- ☐ Almost every day

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Travel behavior changes due to COVID-19 pandemic

22. During the second wave of the pandemic (from August 2020 to now), what transport mode did you mainly use for commuting trips (to and from workplace)? *

Mark only one oval.

- ☐ Private cars
- ☐ Public transport (bus, tram, ferry)
- ☐ Walking
- ☐ Private bicycles/scooter
- ☐ Shared bicycles/scooter
- ☐ Private motorcycle
- ☐ Taxi or Ride-hailing (e.g., Uber)

Daily behavior during the second wave of the pandemic (from August 2020 to now)

Please recall the daily behavior during the second wave of the pandemic (from August 2020 to now) and answer the following the questions according to your real experience.

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Travel behavior changes due to COVID-19 pandemic

23. During the second wave of the pandemic (from August 2020 to now), how often did you do the following shopping/dining behavior? *

Mark only one oval per row.

	Never or hardly	Several times per year	1~3 times per month	1~2 times a week	3~4 times a week	Almost every day
Go shopping for household supplies (e.g., food and grocery)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Have meals at a restaurant or shop	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Order food delivery from restaurants or shops	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Online shopping for daily supplies (e.g., food, grocery and clothing)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

24. During the second wave of the pandemic (from August 2020 to now), what transport mode did you mainly use for shopping trips? *

Mark only one oval.

- ☐ Private cars
- ☐ Public transport (bus, tram, ferry)
- ☐ Walking
- ☐ Private bicycles/scooter
- ☐ Shared bicycles/scooter
- ☐ Private motorcycle
- ☐ Taxi or Ride-hailing (e.g., Uber)

<https://docs.google.com/forms/d/1np4ZwoaqVX2qwg2RT5CZgw4y7zx8fNm5hPBqYWoaw/edit>

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Travel behavior changes due to COVID-19 pandemic

25. During the second wave of the pandemic (from August 2020 to now), how often did you do the following social/leisure/recreational activities? *

Mark only one oval per row.

	Never or hardly	Several times per year	1~3 times per month	1~2 times a week	3~4 times a week	Almost every day
Activities at public locations (e.g., bars, cinema and shopping malls)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Activities at private locations such as home, friends'/relatives home	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Virtual or online activities (e.g., e-game, video and activities)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

26. During the second wave of the pandemic (from August 2020 to now), what transport mode did you mainly use for leisure/social trips? *

Mark only one oval.

- ☐ Private cars
☐ Public transport (bus, tram, ferry)
☐ Walking
☐ Private bicycles/scooter
☐ Shared bicycles/scooter
☐ Private motorcycle
☐ Taxi or Ride-hailing (e.g., Uber)

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Travel behavior changes due to COVID-19 pandemic

Daily behavior after COVID-19 is no longer a threat in the future. (e.g., enough vaccines)

In the near future, the COVID-19 will be no longer a threat (e.g., enough vaccines). Imagining you are in that time, and answer the following the questions according to your plans.

27. When COVID-19 is no longer a threat, how often are you likely to work/study from home/telecommuting? *

Mark only one oval.

- ☐ Never or hardly
- ☐ Several times per year
- ☐ 1~3 times per month
- ☐ 1~2 times a week
- ☐ 3~4 times a week
- ☐ Almost every day
- ☐ Do not work/study

28. When COVID-19 is no longer a threat, what transport mode will you mainly use for commuting trips (to and from workplace)? *

Mark only one oval.

- ☐ Private cars
- ☐ Public transport (bus, tram, ferry)
- ☐ Walking
- ☐ Private motorcycle, bicycles/scooter
- ☐ Shared bicycles/scooter
- ☐ Private motorcycle
- ☐ Taxi or Ride-hailing (e.g., Uber)
- ☐ Do not commute

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Travel behavior changes due to COVID-19 pandemic

29. When COVID-19 is no longer a threat, how often will you do the following shopping/dining behavior? *

Mark only one oval per row.

	Never or hardly	Several times per year	1~3 times per month	1~2 times a week	3~4 times a week	Almost every day
Go shopping for household supplies (e.g., food and grocery)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Have meals at a restaurant or shop	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Order food delivery from restaurants or shops	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Online shopping for daily supplies (e.g., food, grocery and clothing)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

30. When COVID-19 is no longer a threat, what transport mode will you mainly use for shopping trips? *

Mark only one oval.

- ☐ Private cars
☐ Public transport (bus, tram, ferry)
☐ Walking
☐ Private bicycles/scooter
☐ Shared bicycles/scooter
☐ Private motorcycle
☐ Taxi or Ride-hailing (e.g., Uber)

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Travel behavior changes due to COVID-19 pandemic

31. When COVID-19 is no longer a threat, how often will you do the following social/leisure/recreational activities? *

Mark only one oval per row.

	Never or hardly	Several times per year	1~3 times per month	1~2 times a week	3~4 times a week	Almost every day
Activities at public locations (e.g., bars, cinema and shopping malls)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Activities at private locations such as home, friends'/relatives home	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Virtual or online activities (e.g., e-game, video and activities)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

32. When COVID-19 is no longer a threat in the future, what transport mode will you mainly use for leisure/social trips? *

Mark only one oval.

- ☐ Private cars
- ☐ Public transport (bus, tram, ferry)
- ☐ Walking
- ☐ Private bicycles/scooter
- ☐ Shared bicycles/scooter
- ☐ Private motorcycle
- ☐ Taxi or Ride-hailing (e.g., Uber)

Attitudes and risk perceptions

<https://docs.google.com/forms/d/1np4ZwoaqVX2qwg2RT5CZgw4y7zx8fNvm5hPBqYWoaw/edit>

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Travel behavior changes due to COVID-19 pandemic

33. Have you tested positive for COVID-19? and How severe were the symptoms? *

Mark only one oval.

- ☐ Yes, severe symptoms
☐ Yes, slight symptoms
☐ No, I was not infected

34. Have your friends or close acquaintance been infected by COVID-19? and How severe were the symptoms? *

Mark only one oval.

- ☐ Yes, severe symptoms
☐ Yes, slight symptoms *Skip to question 35*
☐ No, no friends or acquaint were infected

Attitudes and risk perceptions

35. During the pandemic, how did your physical activities (e.g., sports, hanging out and out-door activities) change as compared to the situation before the pandemic? *

Mark only one oval.

- ☐ Much less
☐ Somewhat less
☐ The same
☐ Somewhat more
☐ Much more

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Travel behavior changes due to COVID-19 pandemic

36. During the pandemic, how did your subjective life well-being change as compared to the situation before the pandemic? *

Mark only one oval.

- ☐ Much worse
☐ Somewhat worse
☐ The same
☐ Somewhat better
☐ Much better

37. During the pandemic, how did your financial situation change as compared to the situation before the pandemic? *

Mark only one oval.

- ☐ Much worse
☐ Somewhat worse
☐ The same
☐ Somewhat better
☐ Much better

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Travel behavior changes due to COVID-19 pandemic

38. Please rate your agreement with the following statements: *

Mark only one oval per row.

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
Health impact of COVID-19 is serious if infected	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The spread of COVID-19 is difficult to control	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is difficult to treat COVID-19 if infected	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am very afraid of being infected by COVID-19	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
We should wear masks for preventing COVID-19	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

39. How do you perceive the risk of being exposed to the COVID-19 virus while performing the following activities during the pandemic? *

Mark only one oval per row.

	Very low risk	Low risk	Medium risk	High risk	Very high risk
Work in your workplace	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Activities at public locations (e.g., shopping, restaurant and malls)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In the public transit (e.g., bus and tram)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Physical meeting with others	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Demographic attributes

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Travel behavior changes due to COVID-19 pandemic

40. Gender *

Mark only one oval.

- ☐ Male
☐ Female
☐ Prefer not to say

41. Age *

Mark only one oval.

- ☐ <18
☐ 18~30
☐ 30~45
☐ 45~65
☐ >65

42. Nationality *

Mark only one oval.

- ☐ Sweden
☐ European countries
☐ China
☐ Asian area
☐ North American
☐ South American
☐ Other

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Travel behavior changes due to COVID-19 pandemic

43. Highest completed education *

Mark only one oval.

- ☐ No completed education
- ☐ High school graduate
- ☐ Bachelors degree
- ☐ Masters degree
- ☐ Professional or doctorate degree
- ☐ Other

44. Do you have access to using a private car whenever you want? *

Mark only one oval.

- ☐ Yes
- ☐ No

45. Do you live by yourself or with others? *

Mark only one oval.

- ☐ Live alone
Skip to section 17 (Thank you a lot for your support and finishing the survey!)
- ☐ Live with friends *Skip to question 48*
- ☐ Live with family *Skip to question 48*

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Travel behavior changes due to COVID-19 pandemic

46. Individual pre-tax monthly income (including all income sources) *

Mark only one oval.

- ☐ Have no income
- ☐ Below 15 500kr
- ☐ Between 15 500~23 200 kr
- ☐ Between 23 200 kr~40 000 kr
- ☐ Between 40 000~61 900kr
- ☐ Above 61 900 kr

47. The postcode of your living areas (for example mine is 41325) *

Skip to section 17 (Thank you a lot for your support and finishing the survey!)

Households

48. How many people in your household? *

Mark only one oval.

- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5+

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Travel behavior changes due to COVID-19 pandemic

49. Overall monthly income of all your family members *

Mark only one oval.

- ☐ Below 31 000kr
- ☐ Between 31 000~46 400kr
- ☐ Between 46 400~123 800kr
- ☐ Above 123 800kr

Thank you a lot for your
support and finishing the
survey!

Your contributions make a big difference to our research and help
preventing/dealing with other epidemic issues in the future in
Sweden.

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