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Keywords

Leisure trips, COVID-19, gender, behavioural change, travel behaviour

Abstract

This report summarizes 2 studies. The first study presents an analysis of the changes in travel patterns in Sweden during the COVID-19 pandemic. The study found that men tended to change their travel destinations but not the number of trips made, while women changed both their travel destinations to shorter trips and the number of trips made. The frequency of work-related travel decreased across all periods studied, while service and leisure trips remained relatively unchanged in frequency but saw a shift in destinations, resulting in shorter trips and a smaller activity area. The result indicates that rather than focusing on restricting car use, strategies that promote shorter trips and encourage changing activities as a form of decoupling between accessibility and mobility for leisure trips. A scenario analysis was also conducted to calculate the potential of reducing routine car use, such as by changing from daily car use to using a car only a few days a week. The results suggest that minor shifts like this could lead to a reduction in transport work, emissions, and kWh by approximately 20%.

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Foreword

This report presents results from the project Energy efficiency of car-borne leisure trips. The project has been financed by the Swedish Energy Agency during the period 2019 – 2023. The project originally consisted of a doctoral project. In order to analyze the effects of Covid restrictions on travel patterns, the research group also applied for additional funding to do more focused research on these effects.

This report summarizes the main findings with respect to mobility impacts as a result of COVID-19 as well as sustainability potentials. Parallel to this report, articles have been written for scientific publication and reporting other parts of the project. The results have also been reported via various channels such as conferences and seminars.

The project has been carried out as a collaboration between Lund University and Trivector Traffic.

The project has been carried out by Professor Lena Winslott Hiselius (project leader), PhD student Emma Strömblad, Tekn. Dr. Helena Svensson at Lund University, Tekn. Dr. Lena Smidfelt Rosqvist, Tekn. Dr. Emeli Adell and civ ing David Carpenfelt at Trivector Traffic.

Summary

This report provides a summary of three studies, the first of which examines changes in travel patterns during the COVID-19 pandemic in Sweden and the lessons that can be learned for sustainable mobility. The study utilized two datasets, one collected before the pandemic and the other during its first year. The impact of pandemic-related restrictions on travel behaviour was analysed across different groups based on lifestyle, work, and means of transport, with a particular focus on gender differences.

The study found that men tended to change their travel destinations but not the number of trips made, while women changed both their travel destinations and the number of trips made, opting for shorter trips. Work-related travel decreased across all periods studied, indicating a potential for changes in travel behaviour. Service and leisure trips remained relatively unaffected in frequency but saw a shift in destinations, resulting in shorter trips and a smaller activity area. Overall, the study suggests that people demonstrated adaptability to change their travel behaviour while still meeting their daily needs, indicating a potential for changes in travel behaviour in the future.

The report highlights that promoting shorter trips and encouraging changes in activities could be a more effective strategy for achieving sustainable mobility than restricting trips.

A scenario analysis was conducted to estimate the potential for reducing routine car use based on current travel behaviour. The results showed that even minor shifts, such as changing from daily car use to using a car only a few days a week, could lead to a reduction in the number of car kilometres, emissions, and kWh by approximately 20%.

Content

1. Introduction

The transport system is under pressure to reduce its greenhouse gas emissions. Mobility needs to change to be sustainable and to meet the urgent climate and environmental challenges while not neglecting our needs or social justice (Holden et al., 2017). Transport is responsible for almost 25% of global energy-related greenhouse gas emissions, a share that is increasing (EEA, 2018). Though no clear definition of sustainable mobility is agreed upon the concept has been used since the early nineteen nineties and the Green Paper on Transport (EC, 1992). To achieve sustainable transport a variety of strategies are suggested, including reducing mobility in developed countries. However not uncontested there is a growing agreement among transport researchers that the level of traffic need to be reduced for the sector to contribute to more sustainable development (Zito & Salvo 2011; Cohen et al., 2016; Holden et al., 2020; Giffiths et al., 2021).

With the continuous and fast COVID-19 virus spread at the beginning of the year 2020, many countries implemented restriction measures and full lockdowns. The level and strategy of restrictions varied between countries (Bin et al., 2021). However, the level (or the strength) of protective measures also varied country-wise during the pandemic following the development of the spread and onset of COVID-19 (Sabat et al., 2020; Broek-Altenburg and Atherly, 2021). Unlike many other countries, the Swedish authorities and government, based on the Swedish constitution, lack far-reaching possibilities to close down operations and forcibly isolate the population. Instead, the strategy to handle the spread was mainly based on recommendations from the national public health authority. The protective measures that were introduced varied between activities where some were banned (e.g. concerts) while some were subject to recommendations (e.g. wearing face masks in public transport) (The Swedish Corona Commission, 2021). For some places (e.g. stores), bans and restrictions on the number of persons being allowed, were not introduced until the late part of 2020 as the Swedish temporary pandemic law came into place. Whilst there are studies following the variation in mobility between different waves of the pandemic e.g. Beck and Hensher (2020) and Molloya et al (2020) there is a lack of (as pointed out by Bin et al., 2021) knowledge on how travel behaviour varies with different restriction conditions. The (in comparison with other countries), rather mild restrictions implemented in Sweden provide an interesting situation to learn from since changes are more influenced by individual adaption strategies than purely enforced adaption.

In reaching for a more sustainable transport system, all trips need to be addressed but until now most efforts have been directed towards work-related trips (e.g. database of www.eltis.org). Although focusing on commuting makes sense if the purpose is to solve problems with congestion or local problems with poor air quality, it makes less sense if the aim is to address the global climate issue, in which case it is equally important finding measures to reduce leisure vehicle mileage. One major contributor to total emissions from transport in Sweden is trips to leisure activities. Such trips account for a significant proportion of the overall passenger mileage by car, and thus also for a substantial share of greenhouse gas emissions. In Sweden, leisure travel (including holiday trips) makes up 43 per cent of the total distance travelled by car per year, based on data from 2011 to 2014 (Winslott Hiselius and Smidfelt Rosqvist, 2018). The conditions and overall results from Sweden are in line with data from other European countries. However, less is known about the car-reducing potential of leisure trips or the anatomy of everyday leisure trips for e.g. social and recreational reasons (Ettema and Schwanen, 2012). Further, mode alternatives and policies are rarely designed specifically to fit leisure trips (Davies and Weston, 2015). Such knowledge is needed to be able to find appropriate measures for those to be addressed.

The aim of this report is two-fold. It is partly to analyse overall changes in leisure travel patterns with associated adjusted protective measures in Sweden throughout a full year of the COVID-19 pandemic to discuss implications for the sustainability transition of mobility. To further address research gaps, we analyse the sustainability potential of a reduction in car use for leisure trips in the Swedish population and discuss its policy implications. Further, we make a quantitative analysis of the effects on leisure trips (car mileage, kWh, and CO_2 emissions) based on a scenario where there is a change in car use habits.

2. Adaptation of travel behaviour due to COVID-19

2.1. Method

2.1.1 Definition of periods during COVID-19

To study changes in travel behaviour between periods with more and less hard protective measures, four studied periods during COVID-19 are defined based on the level of recommendations, restrictions, and bans given but also mobile phone data on mobility and the number of deceased.

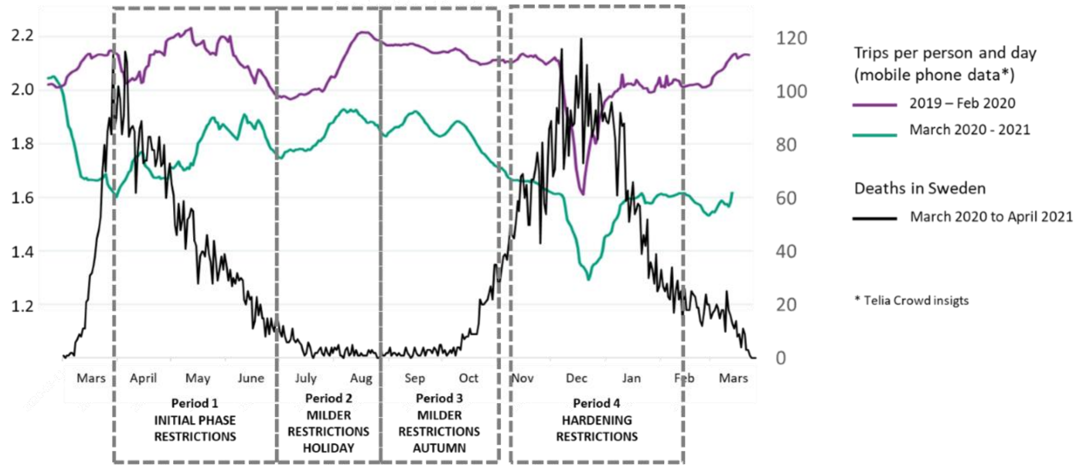

Figure 1. Identified periods based on Pandemic situation.

In Figure 1 the number of trips per person and day in Mars 2019 - February 2020 and Mars 2020 - February 2021 is presented based on mobile phone data (Telia) together with statistics on the registered number of deaths in Covid in Sweden (National Board on Health and Welfare). As mentioned in the introduction and presented in Appendix, the degree of protective measures introduced varied over time relating to the spreading of the virus and the number of deaths. As Figure 1 indicates, the number of trips per person and day was highly influenced by the pandemic development, degree of recommendations, restrictions, and bans given.

Based on this information, four periods during Mars 2020 – February 2021 were identified, with approximately the same situation regarding infection spread of COVID-19, influence on travel, and protective measures. They can be generally described as:

Period 1: Pandemic situation week 13-25. The initial period with recommendations and bans introduced mainly directed toward leisure activities. A high influence on the number of trips compared to the year before. A high number of deaths in the beginning. Lower levels towards the summer.
Period 2: Pandemic situation week 26-32. The number of trips was less affected compared to period 1. Milder restrictions from summer vacation.
Period 3: Pandemic situation week 33-43. The spreading increased at the end of this period and the number of trips dropped again. A low number of deaths.
Period 4: Pandemic situation week 45-06 Very high levels of deaths, hardening restrictions, and more bans mainly directed at leisure activities and shopping. Recommendations on distance education again. Significant influence on the number of trips compared to the year before.

The Swedish strategy included only recommendations for travel saying that unnecessary travel should be avoided. The only restriction on travel was stopping non-citizens from non-EU / EEA countries from entering the country. When separating bans, restrictions, and recommendations on activities (see Appendix), differences can be identified. Measures directed towards leisure activities, shopping, etc were generally given as bans and stricter as the pandemic developed and necessary legislation came into place, whereas measures towards work and education generally were expressed as recommendations. Also, measures directed toward travel were expressed as recommendations.

2.1.2 Data collection and analysis

In this study, travel behaviour collected through the mobile phone app TravelVu is used. Once participants have downloaded the TravelVu app it continuously and passively collects data in real-time on location (GPS). When the user is in motion, the app starts to send data to a server, and data are transferred into speed and acceleration profiles. The analysed data with suggested travel patterns are continuously sent back to the app where participants can view their data with distance, time, route, and suggested mode of transport for each trip. The users enter data about the errand for each destination/trip in the app since errands are not suggested the first time a destination is visited. If needed the user can edit the suggested mode of transport, start and stop times, and distance of trips and even correct the recorded route. Algorithms are based on a fuzzy logic approach on several different variables (e.g., mean speed and percentile speed), to identify the most likely mode of transportation for each trip segment. All participant data are anonymous. Using these data, TravelVu provides detailed information on a single participant's travel behaviour. In the data processing, the data is also run through a standardized quality check using the same criteria for travel length as used for the Swedish national travel survey. Two individuals were removed based on unreasonable travel lengths. The study further focus on surface-based transport modes and trips by air are thus excluded.

In order to compare the travel behaviour between the identified periods during the pandemic situation and the same weeks in the pre-pandemic situation (that is the year before) a panel of data is used. In the panel, there were 268 participants during one year with COVID-19 (starting spring 2020) and 286 participants in the data panel one year foregoing the studied COVID-19 period. The data set (as presented in Tables 1 and 2) is further weighted using multiplicative weights to adjust for skewed distribution in age and gender between studied periods. Multiplicative weights were used, i.e. weights may be multiplied by age and gender. If information on age or gender was missing, only the weight was used where information was available. If the information on both age and gender was missing, the weight was set to 1, i.e. unweighted. No geographical weight was applied as our material cover people living in bigger and smaller cities as well as in non-urban areas, see Figure 2.

Table 1 Gender distribution in the datasets. (w- week number)

Gender (n)	Before pandemic (2019/2020)					Covid period (2020/2021)					Total
	Period 1 w.13-25	Period 2 w.26-32	Period 3 w.33-43	Period 4 w.45-06	Tot	Period 1 w.13-25	Period 2 w.26-32	Period 3 w.33-43	Period 4 w.45-06	Tot	
Female	46	21	38	34	139	49	26	36	22	133	271
Male	49	24	37	22	132	41	25	37	22	125	257
Other/N.a	5	2	4	5	16	5	1	1	3	10	26
Total	100	47	79	60	286	95	52	74	47	268	554
% females out of total number female/male	48%	47%	51%	60%	51%	54%	51%	49%	50%	51%	51%

Table 2 Age distribution in the datasets. (w-week number)

Age group (%)	Before pandemic (2019/2020)					Covid period (2020/2021)					Total
	Period 1 w.13-25	Period 2 w.26-32	Period 3 w.33-43	Period 4 w.45-06		Period 1 w.13-25	Period 2 w.26-32	Period 3 w.33-43	Period 4 w.45-06		
16-29	5%	7%	14%	13%		14%	13%	16%	9%		12%
30-44	35%	27%	39%	39%		24%	28%	32%	39%		32%
45-64	45%	43%	33%	39%		54%	47%	44%	39%		44%
65-	15%	23%	14%	9%		7%	12%	8%	13%		12%

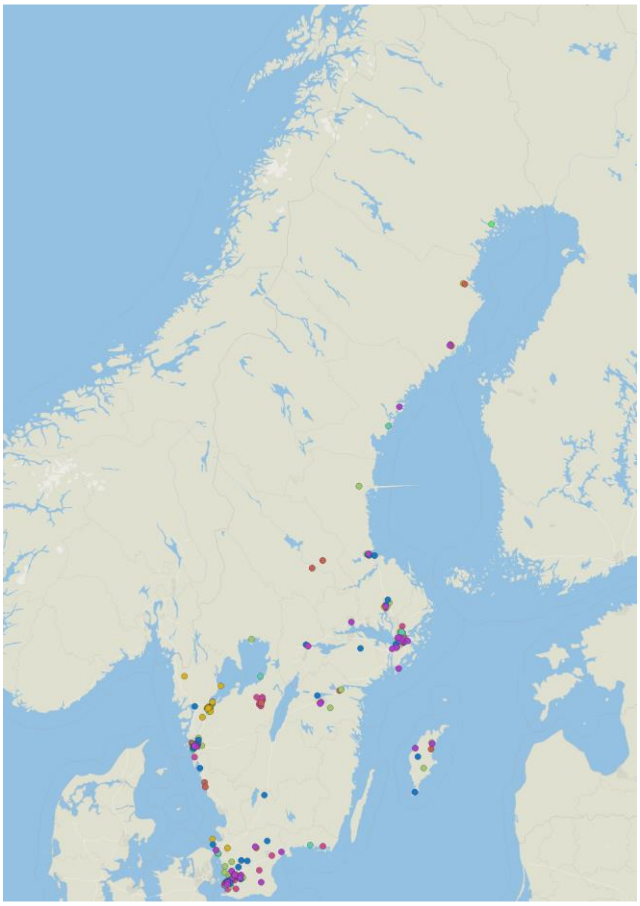

Figure 2 Geographical spread of data sets

The setup for analysis was arranged to be able to follow everyday travel behaviour between pandemic periods and compared it to everyday pre-pandemic behaviour. We study three types of categories of errands: work and school (including business/study trips), service (including shopping), and leisure. Statistics on the average number of trips per person and day, average mileage per person and day, and average mileage per trip for the pre-pandemic and pandemic situations are analysed and compared. Test of statistical significance is carried out as an independent sample t-test with an assumed equal variance if Levene's test for equality of variances is significant.

2.2. Mobility effects during COVID-19

2.2.1 Number of trips

The result on the number of trips made per person and day shows that the restrictions have an immediate effect on mobility. In the periods with harder restrictions (periods 1 and 4) the total number of trips s significantly reduced, while the change during the summer and early autumn with milder restrictions is non-significant, see Figure 3. The most outstanding change can be found in work-related trips which are reduced throughout all periods. The reduction is the most significant one, almost halving the number of trips during pandemic periods compared to pre-pandemic ones. Trips for service and leisure vary between the periods and no significant reduction is recorded for any period. Trips for service and leisure even seem to increase in periods with milder restrictions, period 2 (service) and period 3 (leisure).

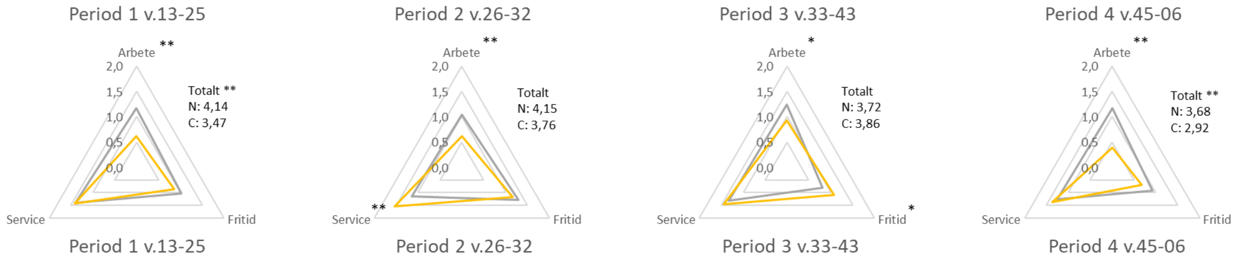

*Figure 3 Number of trips per person and day by type of errand. Figures for all errand together denoted by N: before pandemic and C: during pandemic. Significant differences denoted by ** 5% level, * 10 level.*

As shown in Table 3, public transport has suffered a great loss of ridership through all periods, a reduction of more than 80 % of the trips can be seen in all four periods. Recreational trips (walking or cycling) have had a great upswing throughout the pandemic. The increased cycling that has been reported in the media can not be seen in our results which might have two different explanations. Some of these trips might be in the category of recreational trips and there might also be a variation depending on residential area. Reports of increased cycling have mainly come from bigger cities and our material covers people living in bigger and smaller cities as well as in non-urban areas where reduced use of public transport might spill over to also reduced use of bikes. From summer and early autumn (milder restrictions) and late autumn and winter (harder restrictions) more car trips are made in the pandemic situation (with milder restrictions) compared to the pre-pandemic situation.

*Table 3 Number of trips per person and day by transport modes. Significant differences denoted by ** 5% level, * 10 level.*

	Period 1 w.13-25				Period 2 w.26-32				Period 3 w.33-43				Period 4 w.45-06			
	Before	Covid	Diff	p-vale	Before	Covid	Diff	p-vale	Before	Covid	Diff	p-vale	Before	Covid	Diff	p-vale
Car	1,26	1,47	0,17	0,314	1,19	2	0,68	0,002**	0,93	1,66	0,79	0**	0,72	1,07	0,49	0,071*
blic transp	0,66	0,1	-0,85	0**	0,48	0,06	-0,87	0**	0,75	0,14	-0,81	0**	0,64	0,12	-0,82	0**
Bike	0,81	0,79	-0,03	0,852	0,8	0,67	-0,16	0,512	0,8	0,9	0,12	0,569	0,85	0,52	-0,39	0,07*
Walk	1,34	1,09	-0,19	0,112	1,67	0,99	-0,41	0,002**	1,21	1,07	-0,12	0,389	1,42	1,17	-0,18	0,298
Other	0,07	0,03	-0,62	0,021**	0	0,03	7,77	0,012**	0,02	0,08	2,43	0,14	0,04	0,04	0,11	0,895
Total	4,14	3,47	-0,16	0,017**	4,15	3,76	-0,09	0,259	3,72	3,86	0,04	0,649	3,68	2,92	-0,21	0,025**

The analysis presented in Figure 4 shows that there are differences between men and women. Women significantly reduced their number of trips (significant level for both work-related and leisure purposes) from the start of period 1 while men reduced their trips first in period 4 during the second wave of the pandemic and hard restrictions. This also regards work-related trips, which could be a result of more women using public transport, which has been subject to extreme reductions throughout the pandemic all over the world.

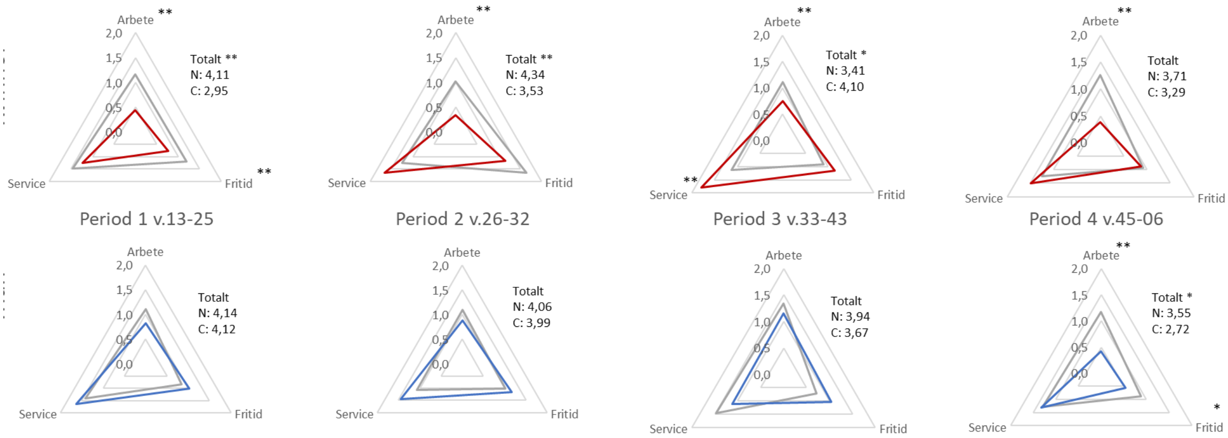

*Figure 4 Number of trips per person and day by type of errand and gender. Figures for all errand together denoted by N: before pandemic and C: during pandemic. First row: Females; Second row: Males. Significant differences denoted by ** 5% level, * 10 level.*

2.2.2 Travel length

The changes are dramatic when it comes to mileage per person and day than for trips. The mileage (presented in Figure 5) dropped throughout all pandemic periods (all significant but period 2) and with significant levels for all periods except the summer (period 2). As for the number of trips, work-related travel has the most obvious reductions. In periods with harder restrictions (periods 1 and 4), the mileage was reduced to about 40 % of pre-pandemic mileage and was reduced also for service (period 1) and leisure (periods 1 and 4). During summer and early autumn (though lighter restrictions), the mileage was reduced to about 70 % of pre-pandemic levels, while the mileage remained about the same during the summer and holidays.

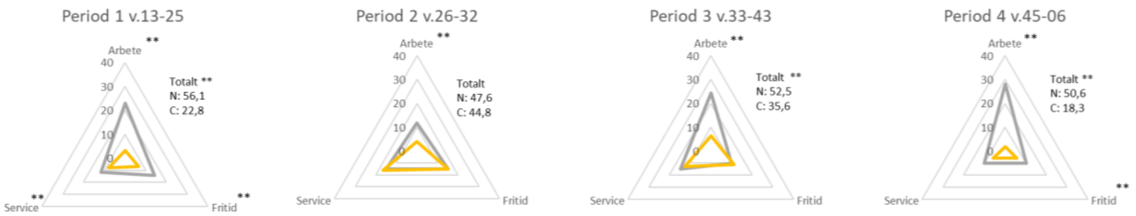

*Figure 5 Average travel length per person and day by type of errand. Figures for all errand together denoted by N: before pandemic and C: during pandemic. Significant differences denoted by ** 5% level, * 10 level.*

In Table 4 the result shows that mileage by public transport suffers the greatest changes for all periods with drops of 80-90 percent. Car mileage dropped when the COVID-19 pandemic started (period 1) but car mileage increased with lifted/lighter restrictions (periods 2 and 3) compared to pre-pandemic. When restrictions were sharper in period 4 again car mileage dropped to pre-pandemic levels. Significance however only for the increase shown in period 2 (and period 3, p<0.10).

*Table 4 Average travel length per person and day by transport mode. Significant differences denoted by ** 5% level, * 10 level.*

	Period 1 w.13-25				Period 2 w.26-32				Period 3 w.33-43				Period 4 w.45-06			
	Before	Covid	Diff	p-vale	Before	Covid	Diff	p-vale	Before	Covid	Diff	p-vale	Before	Covid	Diff	p-vale
Car	22.8	17	-0.25	0.17	27.98	38.92	0.39	0.146	18.35	25.57	0.39	0.092*	11.87	12.25	0.03	0.886
Public trar	29.27	2.38	-0.92	0**	18.35	1.23	-0.93	0**	32.07	6	-0.81	0**	37.22	3.32	-0.91	0**
Bike	2.91	2.69	-0.07	0.731	2.78	2.28	-0.18	0.61	2.5	2.91	0.17	0.548	2.49	1.68	-0.33	0.248
Walk	0.33	0.6	0.81	0.025**	0.7	0.26	-0.63	0.025**	0.38	0.35	-0.08	0.782	0.5	0.54	0.08	0.827
Other	1.86	0.12	-0.93	0.061*	0.01	0.7	93.35	0.147	0.24	1.1	3.64	0.107	0.25	0.06	-0.78	0.082*
Total	57.17	22.8	-0.6	0**	49.84	43.4	-0.13	0.434	53.53	35.93	-0.33	0.012**	52.34	17.85	-0.66	0**

When separating the analysis for gender (presented in Figure 6), the result shows that mileage dropped for men as well as women. Women tend to shorten their mileage drastically already in period 1, where mileage for all types of trips reduces, while men shorten their mileage considerably in the second wave of restrictions (period 4). For work-related trips, the trip length for men and women drops for all periods (sign all periods). Also, trips for service get shorter except in period 2 but only significant for women in period 1. Trips for leisure purposes became shorter at the start of the pandemic for both men and women but then more or less recovered with some variations (mostly not significant). Women seem to act faster to restrictions, while men react more strongly to the second wave of restrictions (period 4) than to the first (period 1).

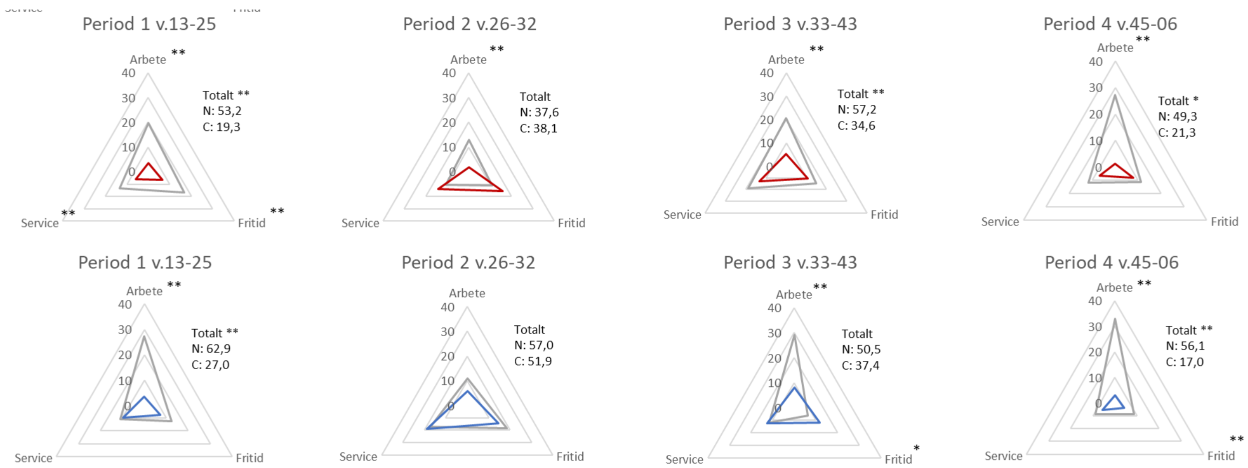

*Figure 6 Average travel length per person and day by type of errand and gender. Figures for all errand together denoted by N: before pandemic and C: during pandemic. First row: Females; Second row: Males. Significant differences denoted by ** 5% level, * 10 level.*

2.2.3 Trip length

As expected from the results showing a reduced number of trips as well as mileage per person and day, there is a general drop in trip length, see Figure 7. At the beginning of the pandemic (period 1) the average trip length is reduced (significant). It applies to both men and women (although it is not significant during the summer for women). The largest reduction is to be found for work trips. Women also shorten their trips for service and leisure under restrictions. Restrictions in the initial period seem to affect the length of journeys more than during other periods. Men mainly shorten their leisure trips in the first and second periods though.

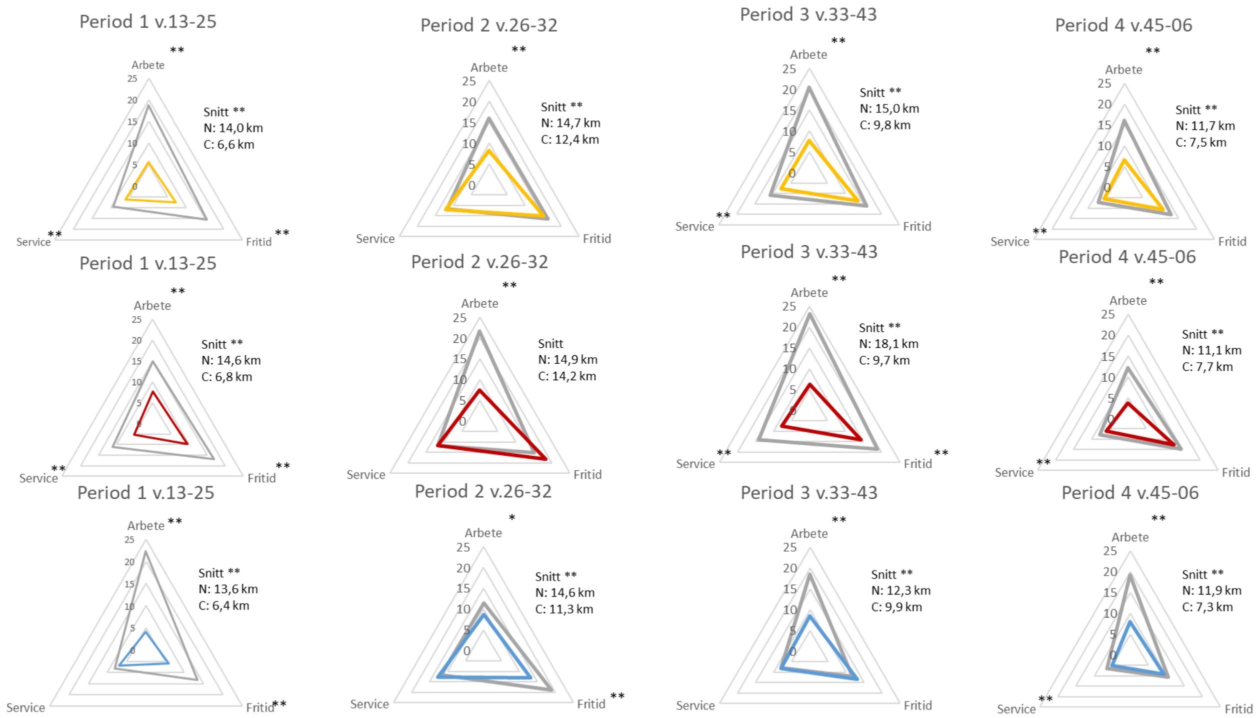

*Figure 7 Average trip length per person by type of errand and gender. Figures for all errand together denoted by N: before pandemic and C: during pandemic. First row: Whole sample; Second row: Females; Third row: Males. Significant differences denoted by ** 5% level, * 10 level.*

3 Identification of sustainability potentials of leisure trips

3.1 Data collection

The data collection was carried out using the same GPS-based mobile phone app TravelVu as in the study previously described (the app is presented in section 2.12). In this case, the data collection was carried out during a one-month travel survey as part of a research study funded by the Energy Agency (Title: Analysis of individual travel variations for robust climate change measures). The recruitment of participants was primarily done through a letter sent to 40 000 a random stratified sample of Swedish residents between 16 and 74 years of age in September 2021. Previous experience with app-based travel survey collection gives that the youngest age group has the lowest response rate (Massey and Tourangeau, 2013; Markstedt, 2012). To balance this 37 % of the letters were sent to this group, 27 % were sent to the oldest group and 18 % respectively to the two middle-aged groups.

Participants included in the “one month study” had to meet the following requirements: 1) At least 70% validated days for a 28-day long period between data collection start (28th of September) and 12th of December. 2) During this period the participant had to have at least two validated days for each weekday (two Mondays, two Tuesdays, etc.) If several periods met these requirements, the period with the highest percentage of validated days was selected. Hence, all participants in the one-month study contributed between 20 and 28 days. Two outliers were removed based on unrealistic data indicating technical failures in registration of the number of kilometres or the number of trips. This design resulted in 475 participants. To improve the representativeness of the data set to the Swedish population, the data were weighted according to age and gender.

The trip purposes used are Work/school, Business, Shopping and service, Leisure and Other. The analysis aimed to quantify the effect of changed travel habits for leisure trips. As in the previous analysis, see Winslott Hiselius and Smidfelt Rosqvist (2017), the quantification was made for car mileage, energy use, and CO2 emissions. The analysis is however in this report based on revealed travel behaviour and not stated behaviour as in previous analyses based on a one-day travel survey e.g. RES 2016.

3.2 Travel behaviour, overview

3.2.1 Gender and age groups

Men are generally making longer leisure trips by car than women except in the age group of 16-29 where women travel longest, see Figure 8. The largest difference in distance is found in the age group of 30-44 where men drive 64% longer distances for leisure per day than women. The general pattern is also shown for number of leisure trips where men make more leisure trips than women again except for the age group 16-29 years, Figure 9. The largest difference regarding the number of trips is to be found for the age group 64+.

Overall, the age group 64+ stands out as the group with the most car kilometres and the highest number of trips made for leisure purposes per day. The result may be interpreted as this group having more time to carry out leisure trips than other age groups and good access to a car. Further, according to the results in Figure 8, the distances travelled increase by age, suggesting that over the coming years, there will be a refill in this age group of people who have previous travel habits of using the car for longer leisure trips. This stress the need to discuss car-reducing measures and alternative means of travel for people in this age group of young older people.

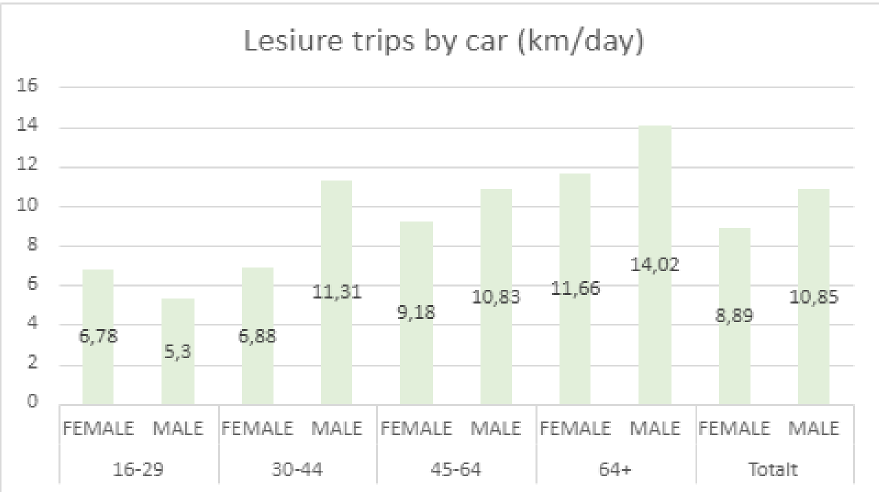

Figure 8. Kilometer travelled per person and day by car for leisure purposes separated for age group and gender.

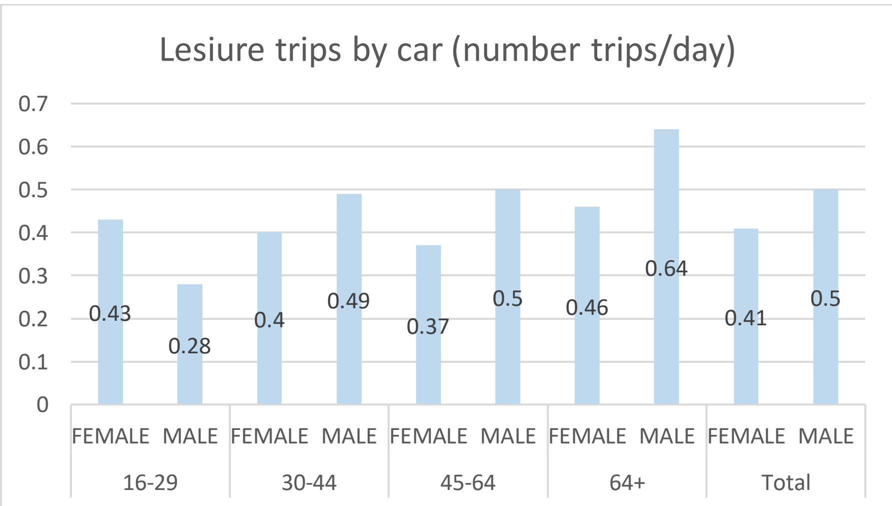

Figure 9. Number of trips per person and day by car for leisure purposes separated for age group and gender.

3.2.2 Gender and geographical context

In order to analyse possibilities to reduce the use of cars for leisure trips we also need to consider the geographical context. The availability of alternative transport modes varies greatly between urban and rural areas and so does the number and type of leisure activities. In Figures 10 and 11, the travel behaviour for leisure is separated for different locations of living and degree of services available in the living area and by gender.

The result in Figure 10 indicates that individuals living outside urban areas travel the longest distance per person and day for leisure purposes and the difference between men and women in this geographical context is small. Of individuals living in urban areas (both with wide and limited range of services), females living in areas with a wide range of services travel shortest distance by car per day for leisure purposes while men living in the same context travel the longest distance.

The result in Figure 11 suggests that besides for individuals in urban areas with a wide range of services, the number of leisure trips by car is almost constant over the categories of geographical areas studied. Individuals living in urban areas with a wide range of services, however, make most leisure trips per person and day. Given that men in areas where alternative modes are available also travel relatively long distances for leisure, this indicates a sustainability potential. The difference in the number of trips made and the distance travelled between men and women suggests that there could be a special interest to analyse men's travel behaviour for leisure trips further.

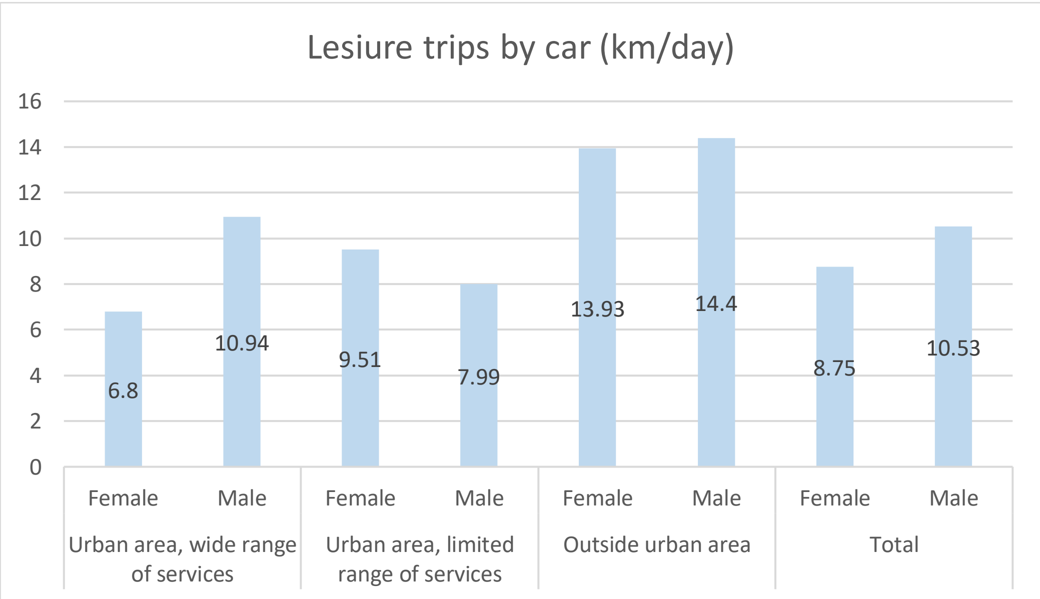

Figure 10. Kilometer travelled per person and day by car for leisure purposes separated for type of area of living and gender.

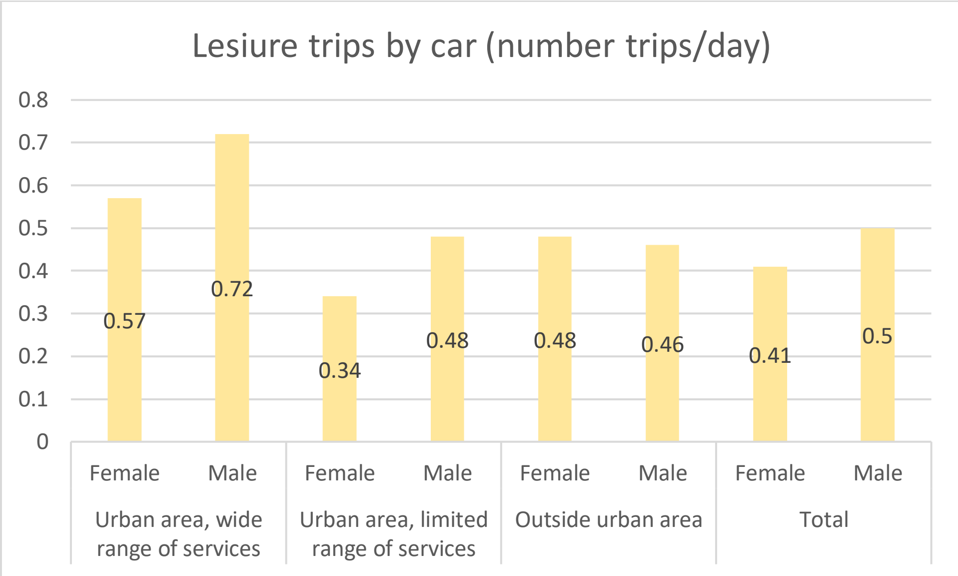

Figure 11. Number of trips per person and day by car for leisure purposes separated for type of area of living and gender.

3.2.3 Gender and car use habits

Figure 12 presents the total number of car kilometres per person per day divided by different segments of car use in the data set analysed, from daily to rare use of the car and by gender. The yellow sections represent travel for leisure. The diagram also illustrates the studied segments' total share of car kilometres in that the x-axis indicates each segment's share of the total population. The result indicates that half of the population uses car daily or a couple of days a week.

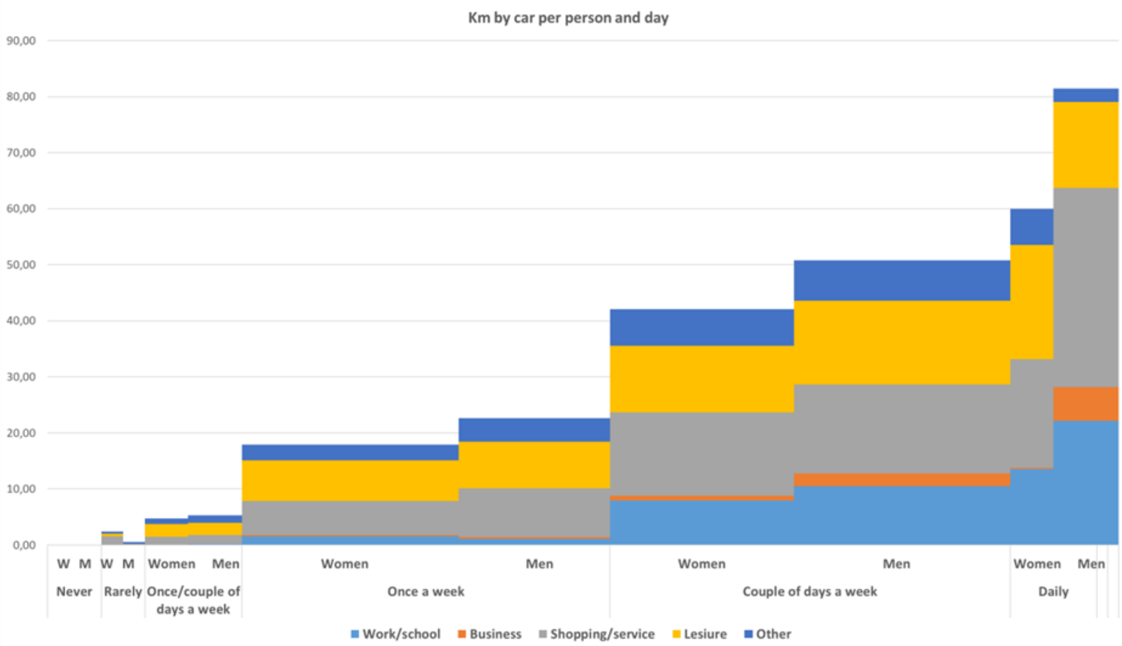

Figure 12 Number of kilometers per person and day by car for different segments of car use frequency and errands.

3.3 Potential reductions in leisure travel based on new car use habits

The overview of travel habits of different groups given in the previous section indicates a reliance on the car for carrying out leisure trips. The results further indicate that there is a large share of the population that carries out the major share of car kilometres. We have therefore constructed a scenario to illustrate what effects changing norms around car use for leisure trips could have on car mileage, CO2, and kWh. This scenario illustrates a change in the habitual behaviour of car use. The scenario is designed so that each car user category is halved, and the other half is moved one step "down" in the car user frequency, starting from car use "Daily". The results presented, show the effect on leisure trip habits for the entire population in Sweden. The analysis is based on a comparison between the travel pattern in a reference scenario (the travel pattern of today) and a scenario where new car use habits have been established also affecting the use of cars for leisure trips.

The calculations based on the scenario indicate a total reduction of the number of car kilometres in Sweden by 24% per year. The reduction is about the same for women and men in absolute values, but slightly greater for women calculated as a relative value (%) since the number of km per day for leisure purposes for women are smaller than for men. CO2 emissions in Sweden from cars and public transport are estimated to be reduced by 21%, which means a reduction of 2,730 tonnes per year. Energy consumption is estimated to decrease by 8.1 GWh per year (18%). This scenario also has the advantage that the number of kilometres with public transport, walking, and cycling would increase significantly by 14%, 26% and 13% respectively (see Table 5).

Table 5. Total number of km per day for leisure trips by mode of travel for today's behaviour (Reference) and for the scenario "New car use habits for leisure trips".

Data: 1 month travel survey with TravelVu						
SCENARIO "New car use habits for leisure trips"						
		Kilometer per mode				
		Car	**Public transport**	**Bike**	**Walking**	**Total**
Reference	Man	43 605 960	17 123 349	1 363 613	1 283 275	65 669 823
	Female	37 194 805	18 475 427	1 241 352	1 136 288	59 881 885
	Total	80 800 765	35 598 776	2 604 965	2 419 563	125 551 708
Scenario	Man	33 853 297	19 589 212	1 697 731	1 360 891	56 501 131
	Female	27 874 053	21 106 453	1 579 893	1 380 403	51 940 802
	Total	61 727 350	40 695 665	3 277 625	2 741 293	108 441 933
Difference	Man	-9 752 664	2 465 864	334 118	77 616	-9 168 692
		-22%	14%	25%	6%	-14%
	Female	-9 320 752	2 631 026	338 541	244 114	-7 941 083
		-25%	14%	27%	21%	-13%
	Total	-19 073 415	5 096 890	672 659	321 730	-17 109 775
		-24%	14%	26%	13%	-14%

4 Discussion and policy implications

As reported in numerous articles from all over the world the COVID-19 pandemic has had a great impact on mobility and transport. However, the results contain more nuances when different errands and the restrictions imposed are studied. Our study design from Sweden has enabled an analysis of changes for different trip purposes in response to different degrees of severity of recommendations and restrictions that apply to different parts of Swedish society during the pandemic.

In this study, we analysed the differences between men and women and their responses to the restrictions. Our findings suggest that men changed their travel destinations, but not the number of trips made, while women changed both their travel destinations to shorter trips and the number of trips made. For work-related travel, changes were steady throughout all study periods, indicating a potential to change travel behaviour. This change was especially significant as some work groups were able to carry out their mission without travelling. It is noteworthy that work-related trips may be perceived as less enjoyable than leisure trips where the trips themselves can be enjoyable. Service and leisure trips were relatively unaffected in frequency, but the destinations changed, resulting in shorter trips and a smaller activity area. Despite the pandemic, people demonstrated adaptability to change their travel behaviour while still maintaining these trips as a necessary part of their daily life. This finding suggests that service and leisure trips, even during more pressing times, provide people with the opportunity to experience the variety and get outside the door.

In many ways, the COVID-19 pandemic holds some differences with the climate crises in the sense of urgency together with the anticipated limited duration but has also similarities in having both individual as well as collective drivers. Some change their pandemic behaviour to protect themselves or a close relative, some out of solidarity with others for them unknown fellow citizens or healthcare personnel. Our study showed that many changed their pandemic behaviour even if not governed by hard restrictions and there is more willingness to change to eliminate a perceived danger than is often communicated. It also showed that there is a great diversity in adoption strategies depending on trip purpose. While work-related mobility seemed fairly easy to replace with digital alternatives, some everyday leisure trips showed lower reductions even though some destinations and kinds of activities no longer existed. The result indicates that strategies for promoting shorter trips and changing activities rather than restricting trips could be seen as a form of decoupling accessibility from mobility. Such a strategy might increase the support for the transition towards future sustainable mobility. The lesson learned is that governance does have an effect (but) needs to meet needs or preferred demands.

Our scenario analysis assumes the potential of a reduction in routine car use based on how individuals travel today. The scenario shows what minor shifts such as a change from daily car use to a few days a week bring in reduced car mileage, emissions, and kWh. For all measures, the reduction is a little over 20%.

The findings of this report indicate a potential for accepted policies for a more sustainable future mobility transition. The changes in leisure mobility in the Swedish case revealed interesting adoptions that could be used for further studies. The changed mobility behaviour during the pandemic regarding going to parties, soccer games, theaters, restaurants, concerts, etc. has swiftly bounced back with lifted restrictions in a way work-related mobility has not.

This is a potential advantage for the sustainability transition in respect of people being able to find more sustainable mobility facing the climate challenge. This calls for further understanding of how policies for more sustainable everyday leisure mobility could be brought about.

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Appendix

GENERAL RESTRICTIONS/RECOMMENDATIONS ON TRAVEL OR GENERAL "STAY AT HOME" *

	Spring 2020	Summer 2020	Autumn 2020/Winter 2020
RESTRICTIONS	No entering of non-citizens from non-EU / EEA countries was stopped from 19 March		
RECOMMENDATIONS	Unnecessary travel was advised against certain countries (January 26 - March 6) and generally abroad (March 14).	From 13 June, the advice on unnecessary travel within Sweden was lifted, and during July and August 2020, Sweden gradually lifted travel restrictions to EU countries, among others	
	Unnecessary weekend trips and other trips within Sweden were not recommended (March 19), as well as trips longer than 1 to 2 hours by car. Avoid travel with public transport. People over the age of 70 were advised to stay at home. (March 16 2020)		

RESTRICTIONS/REKOMMENDATIONS RELATING TO WORK/SCHOOL & BUSINESS TRIPS*

	Spring 2020	Summer 2020	Autumn 2020/Winter 2020
RECOMMENDATIONS	People even with minimal symptoms of what may be covid-19 were recommended to stay at home.	Upper secondary schools were reopened on 15 June,	At tertiary level and other adult education, some distance education continued during the autumn of 2020.
	Employers were advised to encourage their employees to work from home if possible (March 16).		On December 7, the country's upper secondary schools once again were recommended to switch to distance education.
	Distance education was recommended for colleges, municipal adults, polytechnics, colleges and universities. (March 18th)		

RESTRICTIONS/REKOMMENDATIONS RELATING TO LEISURE AND SERVICE TRIPS*

	Spring 2020	Summer 2020	Autumn 2020/Winter 2020
RESTRICTIONS	All gatherings and gatherings with over 500 participants, including cultural and sporting events, were banned from 11 March 2020.		From 1 November 2020, the ban was lifted to allow public events with a maximum of 300 seated participants. At the same time, public dance performances were banned for more than 50 people.
	From 24 March 2020, only food and drink while sitting in restaurants and bars, and only table service was allowed. The ban on all public gatherings and gatherings was changed to cover all general gatherings over 50 people from 29 March 2020.		At the same time, public dance performances were banned for more than 50 people. From 24 November 2020, alcohol serving was prohibited after 10 pm. Also a ban on organizing public gatherings and public events with more than eight participants was introduced on 24 November 2020. From 24 December 2020 alcohol serving was prohibited after 8 pm. The number of people in company at restaurants was reduced from 8 to 4 persons

*Red: restrictions; Beige: recommendations; Green: lifted recommendations