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Plunge and Changed Recurrence of Leisure Activities in the COVID-19 Era – An Analysis of Three Years of Panel Data

Lisa Ecke[a]*, Jan Vallée[a], Miriam Magdolen[a], Lukas Burger[a], Bastian Chlond[a], Peter Vortisch[a]

[a]*Institute for Transport Studies, Karlsruhe Institute of Technology (KIT), Kaiserstrasse 12, 76131 Karlsruhe, Germany*

Abstract

The COVID-19 pandemic has affected everyone's life and how people spend their time. In this surrounding of changes, leisure activities and leisure-related travel gain special attention. Little is known about how affected people behave over time under the circumstances of a pandemic. This paper analyzes the impact of the COVID-19 pandemic on leisure activities and leisure-related travel patterns in Germany. The evaluation is based on the unique data set of the German Mobility Panel (MOP), a panel survey where individuals participate for one week in three consecutive years. The analyses show that the different stages of the pandemic drove changes in how people behave in their free time. During the first fall of the COVID-19 pandemic, significant decreases in travel demand are identified across all sociodemographic groups. With the relaxation of preventive measures during the summer of 2021, the previous plunge of leisure activities between 2019 and 2020 slowly returned in the direction of the initial state of 2019. Furthermore, it can be seen that the impact of sociodemographic characteristics such as gender, economic status or occupation status varies between the years and different leisure travel indicators.

Keywords: Active Travel; COVID-19; German Mobility Panel; Leisure Activities; Outdoors, Panel Data

1. Introduction

Since the beginning of the COVID-19 pandemic in March 2020 (World Health Organization, 2022), people in Germany live in an exceptional situation. To limit the virus spread, federal and regional authorities promoted social distancing and thus mandated preventive measures (Bauer and Weber, 2021). Countries worldwide mandated obligations to wear masks in public, stay-at-home requirements, social distancing, closing shops and restaurants,

* Corresponding author. Tel.: +49-721-608-47773.
E-mail address: lisa.ecke@kit.edu

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school closing, and even workplace closing at different times and with varying scopes of the measures taken. In Germany, the most severe measure was a lockdown enforced in spring 2020 to restrict public life to bare essentials. After the first lockdown period, a period of cautious easing followed at the beginning of summer 2020, again followed by a period of closures and restrictions in winter 2020. With a growing vaccination rate of Germans throughout 2021, further COVID-19 waves were met with less drastic restrictions (Figure 1).

The COVID-19 pandemic has major effects on the frequency of leaving home. Since the declaration of COVID-19 as a pandemic, people behave differently because they fear getting infected or are subject to political measures. Studies show that two effects are primarily evident: First, a generally lower level of travel and second, changes in mode and destination choice (Axhausen, 2020; Follmer and Schelewsky, 2020; Haas et al., 2020; Nobis et al., 2020).

From existing literature predating the COVID-19 pandemic, it is understood that various activities in daily life impose distinct constraints at an individual level. Work and educational endeavors adhere to fixed temporal, frequency, and spatial parameters, thereby qualifying as obligatory pursuits. In contrast, leisure activities exhibit greater flexibility and encompass diverse objectives, ranging from dining out or socializing at pubs, to interacting with friends and family, to engaging in team sports or participating in celebratory events. Leisure activities afford individuals the highest degree of autonomy. Although they do contribute to personal well-being and involve social obligations, such as those found in team sports, their significance for survival is generally less pronounced compared to work or the procurement of daily necessities. In the early stages of the COVID-19 pandemic, the prevailing approach entailed permitting work to proceed while urging individuals to confine themselves to their homes for all other activities.

With regard to the (long-term) changeability of leisure routines, it must be taken into account that variability in leisure activities can be considered temporally, spatially, regarding the frequency, or in terms of interchangeability. Generally, the rhythmics and location of leisure activities are less constrained than, e.g., work which normally takes place at the same place and time. Therefore, leisure travel is more variable (Mallig, 2019; Parady et al., 2020) than other activities (such as work, which often takes place in the same place). Starting from this aspect, we hypothesize for this paper that the COVID-19 pandemic has induced significant changes in the leisure travel behavior of people as they likely adapted to the flexible and variable parts of their everyday travel. Furthermore, we address the questions to what extent the changes differ across different sociodemographic groups and to what extent the changed behavior has reversed again as the impact of the pandemic on everyday life diminishes. For this, the analyses in this paper focus mainly on the reported frequencies of leisure-related travel and its potential for interchangeability. Due to the data structure, it is not possible to analyze spatial changes in leisure activities as well as the time use of respondents when they are at home.

Our research seeks to describe the impacts of the COVID-19 pandemic on leisure activities and identify the initial trends in these changes. For the analysis, we use the German Mobility Panel's (MOP) unique dataset, a panel survey on everyday travel in Germany. Because people are asked to report their everyday travel of one week in three consecutive years, the data enables the unique ability to observe initial trends in changes in leisure activities and leisure-related travel behavior. Statistical analyses of the various indicators are conducted to quantify and examine these changes over the pandemic's first two years with the 2019 survey as a pre-COVID-19 baseline. Furthermore, comparisons across economic status, worker occupation categories, and gender are presented. The analyses illustrate how the observed decline in leisure activities in the first year of the pandemic contrasts with resilience to long-term changes in behavior.

The paper is structured as follows: First, we provide a literature review. We then describe the MOP survey and the research framework. Next, we analyze time use before and during the pandemic and changes in leisure activities, considering various sociodemographic characteristics. This is followed by a discussion of the results and our methods. Finally, we conclude and point out topics for further research.

2. Literature

In this section, we present relevant literature on changes in leisure activities and leisure-related travel during the COVID-19 pandemic. Based on this review we outline the research gap this paper aims to fill.

While everyone knows that the pandemic changed travel patterns, many do not know specifically how things changed in Germany. To shed light into this, we first investigate how the overall travel decline and mode choices changed from 2019 to 2020 and 2021 in Germany, which is the focus of the further analysis, to better understand how

much of these changes are related to changes in leisure travel. The effects of COVID-19 on travel behavior and mode choice were addressed in early studies in 2020 in Germany (Ecke et al., 2020; Ecke et al., 2021; Eisenmann et al., 2021; Follmer and Schelewsky, 2020). While Follmer and Schelewsky (2020) found 2.4 trips (per person and day) in May 2020, Ecke et al. (2020) found 3.2 trips in 2019 and 2.8 trips in fall 2020. Furthermore, Eisenmann et al. found substantial transport mode changes - the car became more important while public transport lost ground. In addition, the study of Ecke et al. also indicates that in 2019, 14% of trips were recreational, whereas in the fall of 2020 (a time when comparatively few virus containment measures were active), 13% of all trips were recreational, and in January and February 2021only 8% were recreational trips. At this time, comparatively many measures were active (Ecke et al., 2021).

Parady et al. (2020) were among the first to examine travel behavior changes in the light of the COVID-19 pandemic at an individual level. Their survey in the Kanto Region in Japan was conducted at the beginning of the pandemic in April 2020. The authors found that, even though the government issued only non-binding self-restriction requests at that time, the frequencies of different out-of-home activities decreased significantly. In particular, higher probabilities of self-restriction for eating out and leisure activities were detected, which were caused by COVID-19 dread and the perception of the self-restriction of others. Shakibaei et al. (2020) conducted a similar survey in Istanbul, Turkey, with three survey waves at different points between January 2020 and April 2020. The study shows that the only activity type undergoing significant decline initially was leisure activities. This indicates that people found leisure activities to be the least essential, quickly reducing them in reaction to the COVID-19 health threats, even before measures to prevent the spread of the virus were announced. After measures were implemented, all activities experienced significant reductions. The frequency of leisure activities dwindled even more than in the beginning.

Bohman et al. (2021) surveyed Malmö, Sweden, in May 2020, asking people to report on changes in their everyday mobility in reaction to the COVID-19 pandemic. The authors found that many activities were subject to spatio-temporal and modal adjustments even though the Swedish government issued no lockdown. Mesaric et al. (2022) found similar changes in behavioral patterns during the post-lockdown period in the summer and fall of 2020 in Switzerland, though with varying degrees of severity for different sociodemographic groups. Bohman et al. (2021) further discovered that Swedes particularly reduced the frequency of social and hobby/sports activities and identified a major shift to outdoor leisure activities (e.g. walking for leisure, exercising outdoors instead of indoors). However, some respondents also reported replacing out-of-home hobby/sports activities with home workouts. These trends were mainly caused by the cancelation of leisure events and efforts of respondents to reduce the risk of a COVID-19 infection. Strömblad et al. (2021) conducted qualitative interviews during the second COVID-19 wave in Sweden in November 2020, exploring the adaptive behaviors of individuals regarding everyday leisure trips. They found that the most common adaptive behaviors were the cancellation of leisure activities and change of transport mode (from public transport to other transport modes). Doing similar activities in different ways (remoding, retiming, relocating, rescheduling, reducing) was, in some cases, even perceived as positive and something that interviewees want to hold on to in the future.

Nikiforiadis et al. (2022) conducted a panel survey in Greece, exploring the travel pattern changes of young adults before the COVID-19 pandemic, during the first lockdown in April 2020 and the second lockdown starting in November 2020. From before the pandemic to the first lockdown, a substantial increase in the physical exercise frequency of respondents was observed, the most frequent activities being walking (78%) and bicycling (12%). However, this increase was not permanent, as the trend was already slightly reversed during the second lockdown. Nobis et al. (2021) discovered in their Germany-wide survey on the changes in everyday travel during the COVID-19 pandemic that in November 2021, two-thirds of the respondents reported a different leisure activity behavior than before the pandemic. They concluded that concerning the everyday travel of Germans, a new normality might have set in in the second half of 2021.

The literature analysis shows that leisure activities were the first activity type to undergo a significant decline during the early stages of the pandemic. In this regard, Nobis et al. (2021) concluded that new normality in times of pandemic might have set in during 2021. However, to the author’s knowledge, no research has coherently examined the changes in leisure-related travel of different sociodemographic groups throughout the first two years of the pandemic on the intra- and inter-individual levels. This paper aims to fill this research gap using panel data from before the pandemic and the fall of 2020 and 2021.

3. Materials and Methods

This section provides an overview of the data that served as a basis for our analyses: the German Mobility Panel. Subsequently, the applied methods are described.

3.1. Data

The analyses are based on the German Mobility Panel (MOP) data. Since 1994, the MOP provides a yearly inventory of everyday travel in Germany. The study is carried out on behalf of and funded by the German Federal Ministry for Digital and Transport. The Institute for Transport Studies of the Karlsruhe Institute of Technology (KIT) is responsible for the design and scientific supervision of the survey (Ecke et al., 2020; Zumkeller and Chlond, 2009). Approximately 3,000-3,400 respondents above ten years in 1,800-2,000 households participate in the yearly survey. The survey period excludes holidays to best capture everyday travel. The respondents are asked to report their daily travel in a so-called trip diary, collecting information on trip distances, means of transport, trip purposes and start and arrival times over a period of seven days (one week). Time use is not recorded in the MOP itself, but can be calculated from the reported travel behavior. This allows determining the time use for the purposes asked in the trip diary, but no more detailed differentiations. For example, time at home can be determined, but it is not known what the person does at home, so they could e.g. also work from home.

Furthermore, sociodemographic information about the participants, the availability of cars, bicycles and public transit passes, etc. are captured. Moreover, respondents are asked to report anomalies such as illness, vacation, and days their car was in the shop. The MOP is designed as a rotating panel, meaning people participate for three consecutive years. Thus, the study allows insights into intraindividual perspectives in everyday travel because each year, all trips of seven days (one week, including weekdays and weekends) are surveyed.

The advantage of continuous panel surveys is that behavioral changes over time can be identified. The 2019 cohort used for the analyses was first surveyed between December 2019 and mid-February 2020 (see Figure 1, 1st report), thus before the outbreak of the pandemic. The other two survey waves of the cohort were conducted during the pandemic in the fall of 2020 and 2021, respectively (see Figure 1, 2nd and 3rd report). During the first survey wave in January and February 2020, hardly any infections were reported in Germany. The second survey wave in the fall of 2020 fell into the second COVID-19 wave in Germany. In this period, preventive measures like closures of restaurants, theaters and sports facilities were reinstated to slow the spread of the virus, though shops and schools remained open (“Lockdown light”). During the third survey wave in fall 2021, one third of Germans were fully vaccinated (Federal Ministry for Health, 2022). Therefore, measures to contain the spread of the virus were weaker than in the same period the year prior, with people fully vaccinated, recovered or tested negative being able to perform all activities desired (3G-rule).

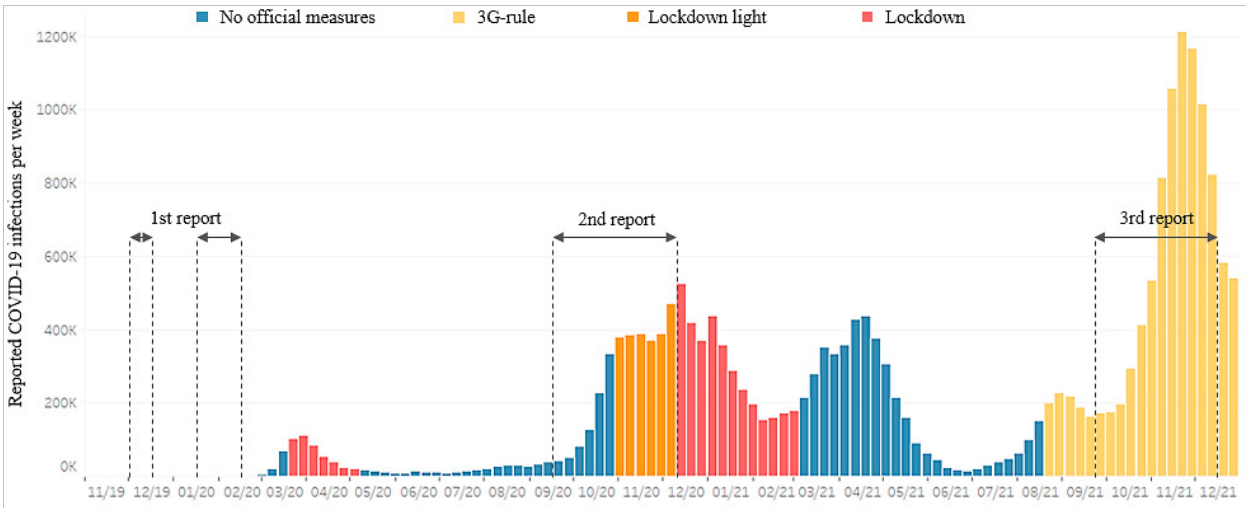

Figure 1. Survey periods of the MOP 2019 cohort and development of COVID-19 infections (19) in Germany (2019-2021)

The primary objective throughout the aforementioned timeframes was to minimize physical interactions and halt the spread of the virus. In certain instances, educational and occupational activities were curtailed, although these measures encountered significant controversy within Germany. Additional actions encompassed the cancellation of large-scale gatherings such as concerts and soccer matches, as well as imposing restrictions on individuals' access to fitness centers. Comprehensive information regarding these measures and spatial limitations can be found in Bauer and Weber's (2021) detailed account.

The MOP allows quantifying changes in travel and out-of-home activities during the pandemic. To this aim, we identify respondents who reported their daily travel for 2019, 2020, and 2021. In total, the data we use contains information from 754 respondents.

Table 1 displays the sociodemographic characteristics of the sample used in 2021. For comparison, the population statistics for 2021 are also provided. The sample from the MOP shows differences concerning the population statistics. This is due to unplanned dropouts within the three years of the report. A study by Chlond et al. (2013) indicates that young respondents are likelier to drop out of the survey prematurely. That is why young respondents are underrepresented in the sample, whereas older respondents are overrepresented. Moreover, the share of respondents with a high level of education is considerable. For the analyses, data is unweighted. Therefore, it must be underlined that this study cannot provide information about the German population starting from analysed data due to the limited sample size. Furthermore, the author is aware that participants may change the (economic) status between years. However, the change of categories was excluded from the analysis.

In addition to the trip diary, an additional questionnaire was used to survey changes in travel behavior during COVID-19 (Ecke et al., 2024). The results of the additional questionnaire are shown in Table 1. “New out-of-home activities” are defined as activity types performed in 2020 but not performed in 2019.

Table 1. Sample characteristics (N=754)

Variable	Level	Population[a] [%]	MOP-sample 2021 [%]	Respondents in 2020 reporting... more time at home [%]	new out-of-home activities [%]	an increase in ICT[b] usage [%]
Total			100.0	57.1	24.4	21.4
Gender	Male	48.5	50.0	54.7	22.6	22.5
	Female	51.5	50.0	54.7	26.1	20.4
Age (years)	< 25	16.p	8.0	54.7	30.2	32.7
	25-35	12.6	5.7	60.7	13.9	41.7
	35-50	19.2	14.5	51.5	45.1	33.0
	50-60	18.4	20.1	49.6	21.8	19.7
	60 +	32.9	51.7	61.3	19.1	11.0
Occupation status	Worker		45.4	54.1	30.6	25.7
	In education		8.1	46.1	25.5	42.5
	Retired		42.0	53.3	24.7	16.8
	Other		4.5	65.0	17.5	11.7
Education	Low		17.9	58.2	27.2	18.7
	Medium		40.2	55.4	19.7	17.1
	High		41.9	59.0	26.9	27.0
Economic status	Low		5.4	50.3	6.0	25.4
	Medium		40.5	58.6	17.5	16.1
	High		54.1	56.9	33.4	25.3

[a] Population statistics are taken from 2021 (Statistisches Bundesamt, 2021)
[b] Information and communication technology

3.2. Research framework

This research uses the data structure to enable a direct comparison between behavior measured before the outbreak and during the first two years of the COVID-19 pandemic. Given the need for insights into the impacts of the COVID-19 pandemic on leisure travel, activities and time use after two years of experience with preventive measures to stop the virus spread, the present work discusses the main findings of the data collected mostly descriptively. Where relevant, indicators, e.g. the calculated number of leisure trips per week, are broken down by sociodemographic characteristics. The multifaceted analyses are structured as follows:

First, it is investigated how people travel around and spent their time in 2019, 2020 and 2021. For this purpose the trips per person are calculated and differentiated for several trip purposes. Trip purposes differentiate the time use for subgroups based on the MOP trip diary data. To account for the "different" behaviors during the pandemic, a differentiation is made between general leisure activities (e.g. playing tennis) and loop trips (e.g. walking the dog). T-tests are performed to check whether time use differs significantly between years.

The following analyses focus on changes in tour characteristics throughout the pandemic. For this purpose, trips are combined into tours. A tour starts and ends at (second) home or hotel and includes at least two trips (outward/return). The only exception are loop trips with only one trip, which starts and ends at the same place. These loop trips usually have a recreational character.

Next, we highlight indicators that provide an overview of changes in leisure activities. We use the following indicators: number of leisure trips per week; share of leisure trips in all trips and share of people doing more than 150 minutes of active travel for leisure trips in a week. For the calculations, loop trips are assigned to leisure trips because we assume that most loop trips are performed during free time and have recreational character (e.g. walking the dog, jogging). Two-sample t-tests are applied to test for the significance of differences in the mean values between different groups at a 95% confidence level. Furthermore, paired t-tests were performed at a 95% confidence level for all groups to check for the significance of differences in the means of indicators between the years. For the interpretation of the results, the assumption is made that many changes in travel characteristics and leisure time spent between the years 2019 until 2021 are a consequence of the COVID-19 pandemic. It is beyond question that there may be other reasons for individuals' differences in behavior between the periods. In preparation for the analysis, we also performed separate analyses for weekend and weekday days (other than for the weekly summaries as presented further), because weekend activities presumably are skewed toward leisure. Since the results do not produce significant differences, they are not presented in this paper.

Based on the descriptive results, linear regression models are built to analyze the influence of different sociodemographic characteristics on the changes in leisure travel during the COVID-19 pandemic. For this, we calculate the difference between the number of leisure trips for 2019 and 2021 on the individual level. The difference serves as the dependent variable. As independent variables, we include several sociodemographic characteristics in the model, such as age, gender, economic status, place of residence, car availability or household size.

In a subsequent analysis, the variability of activities is analyzed. First, we calculate for each person participating in all three years (2019, 2020, 2021), the number of trips to leisure activities, including loop trips for each year. Second, we calculate for each person the standard deviation in the three numbers of leisure activities over the years. To understand this value, we calculate the standard deviation of leisure activities for a comparison cohort. We use the MOP 2017 cohort to examine individuals who participated in 2017, 2018, and 2019 (N=752).

Lastly, the number of days per week with at least one leisure trip is compared across the reporting years to determine the stability of leisure trip frequency. For this purpose, we use the total sum of squares method, a proven method for measuring stability in the number of trips per day (Pas, 1987). The total sum of squares is the sum of squares based on intrapersonal differences (WPSS), and the sum of squares is based on interpersonal differences (BPSS).

$$BPSS = T * \sum_i (\overline{w_i} - \overline{w})^2 \quad (1)$$

$$WPSS = \sum_i \sum_j (w_{ij} - \overline{w_{ij}})^2 \quad (2)$$

T: Number of reporting weeks (T=3)
i: Person
j: Week
w_{ij}: Number of days with at least one leisure trip of person i in week j
$\overline{w}$: Average number of days with leisure trips

The computed indicators become meaningful when compared with those of different cohorts. Therefore, the determined values of the 2019 cohort are compared with those of the 2016 and 2017 cohorts. These cohorts participated in the MOP between 2016 and 2019.

4. Results

4.1. Changes in travel volumes during the pandemic in Germany

In order to provide better context and to better understand the related changes in leisure travel, we first investigate the overall travel decline in Germany. For this, Figure 2 displays the changes in travel volumes for 2019, 2020 and 2021. It can be seen that the total travel volume in 2021 is below the pre-COVID level. For all trip purposes, decreases in the number of trips are evident in the first year of the COVID-19 pandemic. Almost no trips for education were made in January and February 2021 because schools and universities were closed. Minimal changes are evident in errands. A significant decrease is evident in leisure trips.

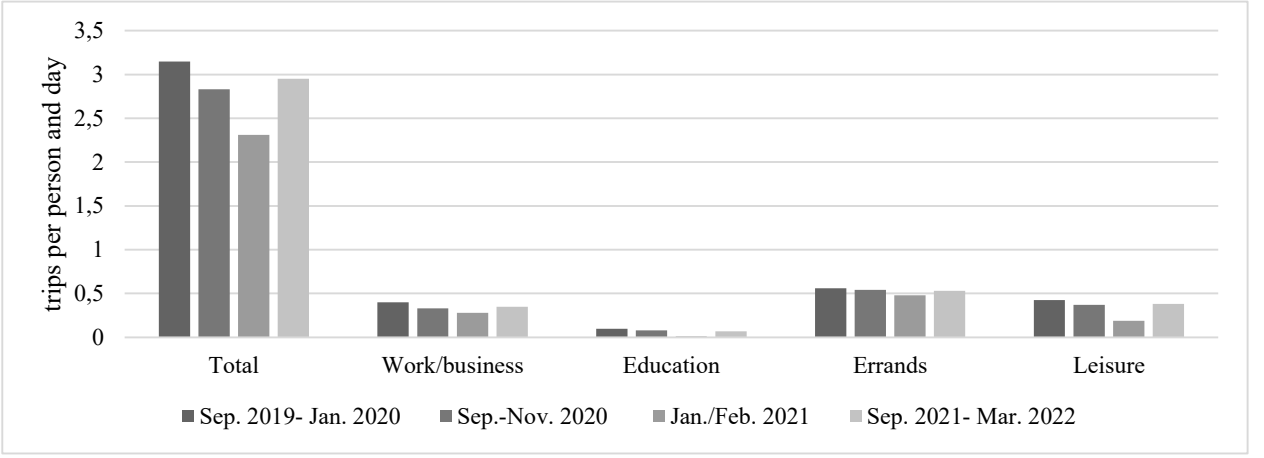

Figure 2. Changes in Travel in 2019-2021 in Germany, differentiated by trip purpose

4.2. General time use before and during the pandemic

Due to stay-at-home measures enforced by (local) authorities, the time use of the 2019 cohort changed significantly during the pandemic. Figure 3 displays the time uses of different sociodemographic groups. On average, the participants increased their time at home significantly from 75% (18.1 hours per day) in 2019 to 79% (18.9 hours per day) in 2021. Further, time spent on compulsory activities (work, school) decreased significantly from 2019 to 2020 and 2020 to 2021. Leisure activities were significantly reduced from 2019 to 2020. However, a slight but insignificant recurrence can be observed from 2020 to 2021. The reduction in leisure activities can be partially explained by a considerable increase in loop trips, which are carried out in particular by bicycle or by foot, underlying their recreational character.

Differences become particularly apparent when the various sociodemographic groups are analyzed. We see, that the proportion of compulsory activities is high among employees and students, while retirees spend only a very small part of their time on compulsory activities. However, the share of compulsory time of employees decreased significantly from 2019 to 2020 and from 2020 to 2021, in each year by about 2% (0.5 hours per day). A significant decrease in compulsory time is evident for students from 2020 to 2021; compared to 2019, compulsory time also decreased by one hour for students in 2021. This additional time was spent at home by both workers and students, which is a strong indication of an increase in working from home. Accordingly, both groups significantly reduced travel time from 2019 to 2020 and 2021, respectively.

All sociodemographic groups significantly reduced the time spent on leisure activities from 2019 to 2020. This was partially compensated by loop trips, for which a significant increase can be observed among nearly all sociodemographic groups. Time spent on private errands like shopping or medical appointments was constant for all

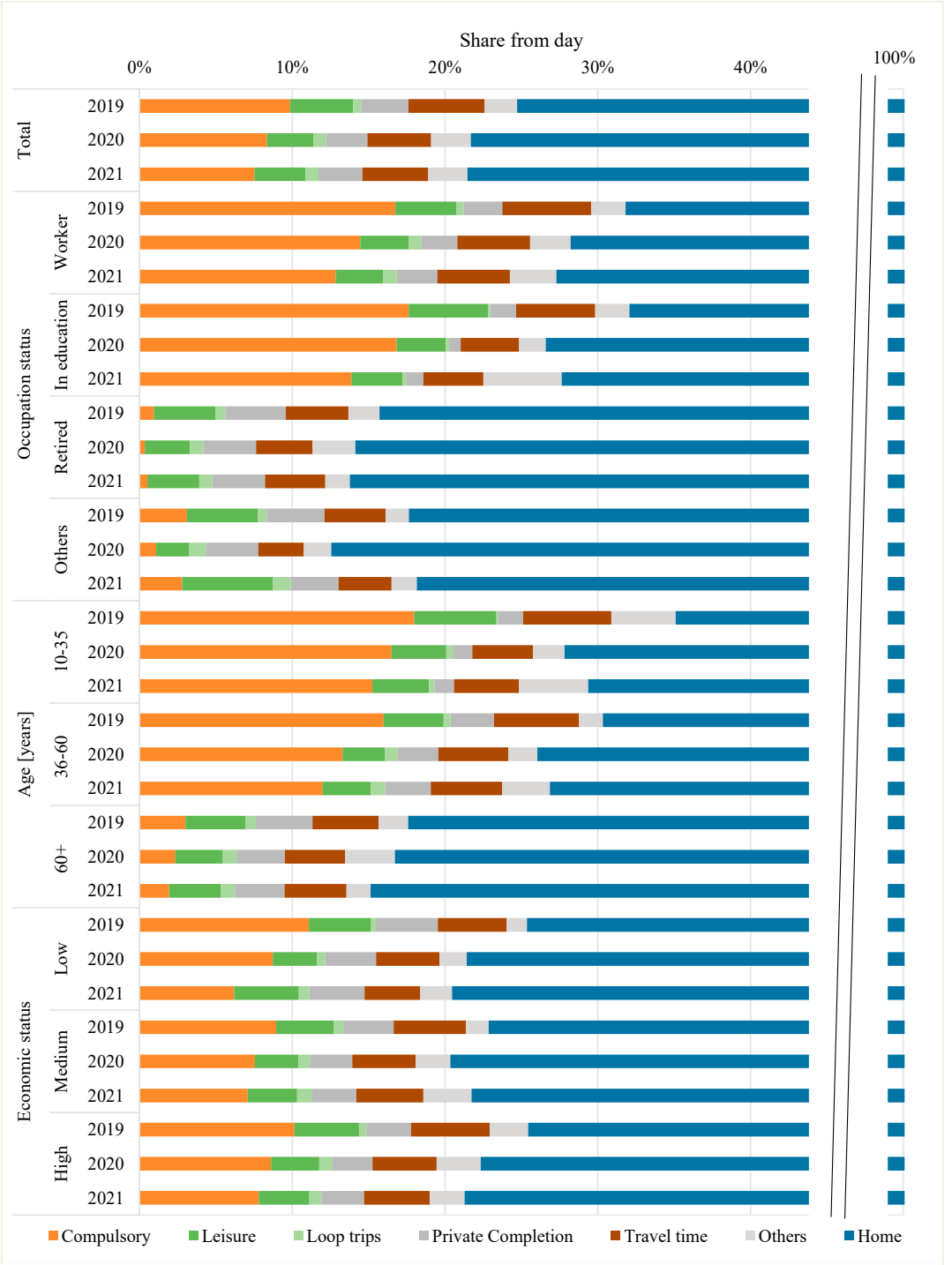

Figure 3. Time Usage of different sociodemographic groups in 2019,2020 and 2021; hidden shares are attributable to being at home

sociodemographic groups except for retirees and elderly people over 60. While grocery shopping was only slightly replaced by online shopping and delivery services, other types of outdoor activities were reduced in 2020 (4).

4.3. Performed activities in 2020

Table 1 shows the major changes in how people spend their leisure time in 2020. 57.1% of the respondents state that they spend more time at home. The proportion is highest among young people (60.7%) and older people (61.3%). As many as one in four people report that in 2020 they spent their free time on activities that they had not done in the previous year. This is particularly true of people with a high economic status. An increase in ICT was also observed in about one in five respondents (21.4%). These technologies are mainly used by people under 50, while with people over 60 only 11% of has been reported. Based on the analysis, it is impossible to show exactly how leisure time activities are structured. However, indications can be found that both older and younger people had to change the way they spent their free time - older people went out less and younger people spent more time with ICT.

4.4. Changes in leisure activities

In this section, the changes in travel for leisure activities during the COVID-19 pandemic are analyzed. For this reason, we compare the characteristics of leisure activities of the 2019 cohort between the three survey waves. As leisure travel is somewhat variable, the identification of changes is complex. For the analysis and interpretation, it must be considered that travel behavior throughout the pandemic had to be adapted to the legal regulations. As shown before, the measures were very restrictive but varied during the survey periods.

4.4.1. Changes in leisure tour characteristics

Figure 4 displays the total number of tours the participants undertake. As observed in the previous section, the number of tours with a leisure component decreased through the pandemic. The decrease was substantial from 2019 to 2020, but the number of leisure tours increased again in 2021. However, it is noticeable that multi-purpose tours with leisure activities also decreased in 2021, while simple leisure tours increased. Loop trips account for a noticeable share of increased leisure tours in 2021. While shopping tours remained relatively constant, work tours were reduced in both years. This also indicates an increase in working from home. The total number of tours decreased in 2020 but recovered slightly in 2021.

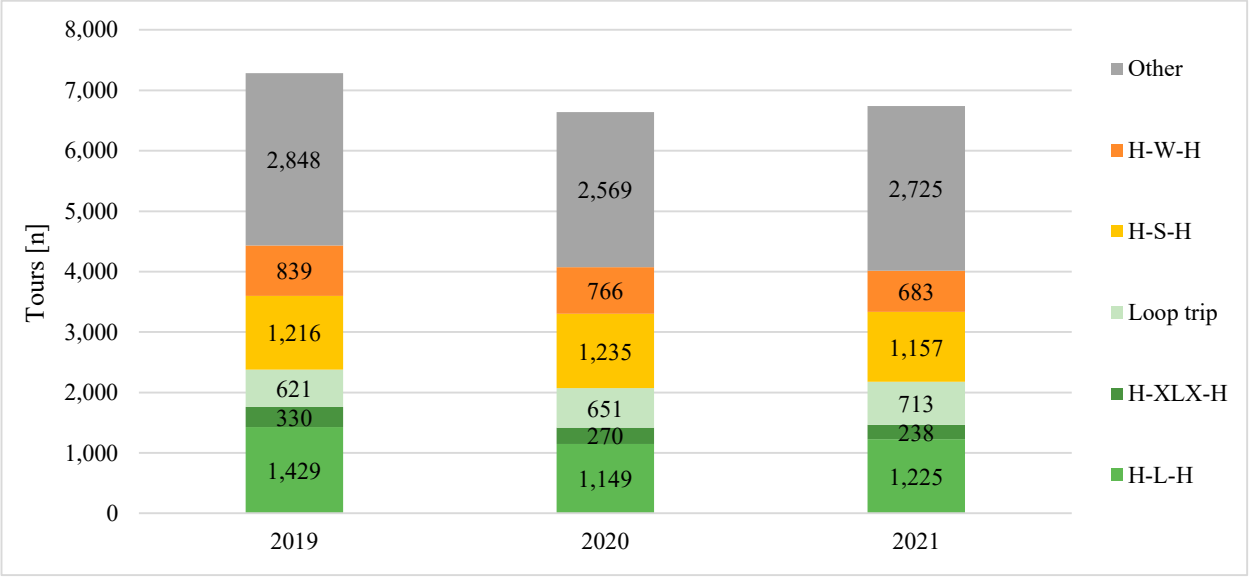

Figure 4. Tour characteristics in 2019, 2020 and 2021; H=home, W=work, S=shopping, L=leisure, Loop trip (e.g. walking the dog, jogging), XLX= multiple trip purposes in one tour with at least one leisure activity, other= other tour characteristics, containing multiple purposes

4.4.2. Changes between sociodemographic groups

Table 2 contains the mean values of different leisure travel indicators for sociodemographic characteristics for 2019, 2020 and 2021 as well as the differences between 2019-2020 (19/20), 2020-2021 (20/21) and 2019-2021 (19/21).

First, we see that the number of leisure trips decreased between 2019 and 2021 for all groups. On average, 4.06 leisure trips per person and week were made in 2019 compared to 3.83 in 2021. In 2019, people with low economic status (3.33 trips) and workers (3.70 trips) reported the fewest leisure trips. Workers differ significantly from retirees, who report 4.32 trips on average. In 2021, students (3.50 trips) and people with low economic status were the groups with the fewest leisure trips. However, no groups differed significantly from each other in 2021. When looking at the increases/decreases in leisure trips over the years, all groups reduced leisure trips between 2019 and 2020. The largest decrease can be seen for people in education (-0.95 trips).

Examining the change between 2020 and 2021, both increases and decreases in the number of leisure trips can be identified. The largest increase is among retired people and people with high economic status (0.27 trips). A decrease is seen among people in education (-0.04 trips). In addition, this group reports the highest increase in the use of ICT in 2020 (42.5%, Table 1).

However, examining the absolute change in leisure trips does not provide information on how the change relates to other trip purposes. For example, if workers no longer make trips to work because they work from home, but perceive no restrictions in their leisure time, then no change in leisure trips in absolute terms can be identified. We even see an increase in the relative share. In 2019 and 2021, retirees have the highest share of leisure trips among all trips (20%). In contrast, workers had the lowest share in both years (14% in 2019 and 15% in 2021) because they made more trips to work than retirees. In both years, the groups differed significantly from each other. Between 2019 and 2020, relative shares decreased for all groups except for workers and people with high economic status. These groups shifted from working to home during the COVID-19 pandemic, creating time for new activities and a change in non-working hours. Between 2019 and 2021, there were also relative decreases (-2.5%) in leisure trips, especially among people in education, because of restrictions in recreational facilities in 2021.

Because many activities were eliminated in the COVID-19 pandemic due to preventive measures to contain the virus, people had to organize their leisure time differently. Since many sports facilities were closed or offered reduced operations, many people exercised outdoors. Therefore, the last analysis is how the share of people who achieved ≥ 150 min active travel in a week changed from 2019 to 2021. The share of people who achieved ≥ 150 min active travel in a week increased from 14% in 2019 to 22% in 2021. In 2019, 3% of people in education reached this goal. Nevertheless, people in education differ significantly from workers and retirees. This can also be observed in 2020 and 2021. Compared to 2019, we see an increase in the relative proportion of people reaching the goal in 2020 for all groups. In 2021, this trend was maintained for retirees (24%) and workers (22%), whereas for students, the share decreased from 10% in 2020 to 5% in 2021. Possible reasons for this are that hobbies such as sports play an essential role for students and that these hobbies were resumed immediately after the measures were relaxed.

Table 2. Leisure travel indicators for 2019-2021 and differences between 2019/2020 (19/20), 2020-2021 (20/21) and 2019-2021 (19/21); significant differences between sociodemographic characteristics are tested by two-sample t-test and are indicated by superscript letters

Indicator			Number of leisure trips /week					Share leisure trips /all trips [%]					Share of people having ≥ 150 min. active travel[1] for leisure trips in a week [%]		
	Year	Letter	**2019**	**2021**	**Δ 19/20**	**Δ 20/21**	**Δ 19/21**	**2019**	**2021**	**Δ 19/20**	**Δ 20/21**	**Δ 19/21**	**2019**	**2020**	**2021**
	Total		4.06	3.83	-0.43	0.20	-0.23	17.1	17.7	-0.5	1.3	0.7	14	22	22
Gender	Male	a	3.86	3.67	-0.38	0.19	-0.19	16.4	17.1	-0.6	1.3	0.7	15 [a]	20	21
	Female	b	4.26	4.00	-0.48	0.22	-0.26	17.9	18.2	-0.4	0.7	0.3	12 [b]	24	23
Occupation status	Worker	c	3.70 [e]	3.62	-0.30	0.22	-0.08	13.9[de]	15.2[e]	0.8[e]	0.5	1.2	10[de]	22 [d]	22 [d]
	In education	d	4.49	3.50	-0.95	-0.04	-0.98	19.1[c]	16.6	-1.4	-1.1	-2.5	3 [ce]	10[cef]	5[cef]
	Retired	e	4.32 [c]	4.06	-0.53	0.27	-0.26	20.1[c]	20.1[c]	-2.0[c]	1.9	-0.1	19 [cd]	24 [d]	24 [d]
	Other	f	4.20	4.13	-0.11	0.03	-0.07	17.6	21.4	2.3	1.6	3.9	13	31 [d]	25 [d]
Economic status	Low	g	3.33	3.10	-0.48	0.25	-0.23	15.5	17.9	-2.0	4.4	2.4	18	23	25
	Medium	h	4.00	3.65	-0.53	0.18	-0.35	17.5	16.9	-0.9	0.3	-0.6	16	21	18 [i]
	High	i	4.15	4.07	-0.35	0.27	-0.08	17.1	18.5	0.1	1.4	1.4	11	23	25 [h]

Two-sample t-tests indicate significance of differences between groups. It is noted with subscript letters ($p<.05$). For example, the notation 10 d,e indicates the share of workers having ≥ 150 min. active travel for leisure trips in a week differs significantly from the share of people in education and retirees

[1] active travel= walking and/or cycling

4.4.3. Changes within sociodemographic groups

Table 3 displays changes between the three reporting years 2019, 2020, and 2021, differentiated by gender, economic status, and employment status. For the 2020-2021 transition, no significant change was measured for any group, so the results are not presented.

However, the number of days with leisure activities says nothing about the number of leisure trips in the reporting week. People may make many (different) leisure trips in one day. Other people, for example, make only one leisure trip in the week. Therefore, we also examine how the number of leisure trips differs between years. Between 2019 and 2020, the number of leisure trips differs significantly for students and retirees, men, women and people with medium economic status. The values for students still differ between 2019 and 2021. For all others, no significant differences are evident in the further comparisons. When comparing the results, it is important to consider that individuals with lower values than others in 2019 also have a lower potential for a significant decrease in leisure trips.

As a general decrease in travel was observed in Germany in the COVID-19 pandemic, eliminating these trips and activities creates new open spaces that can potentially be filled with new/different activities. As shown in Table 1, 57.1% of respondents report fewer out-of-home activities. Almost a quarter report undertaking new activities in 2020 and 21.1% report an increase in ICT. Therefore, it can be assumed that relative trip-purpose changes have also occurred in the COVID-19 pandemic. Thus, we examined how the relative shares of leisure trips in all weekly trips differ between years. The results show no significant changes except for retirees between 2019 and 2020 ($p=0.026$).

Since exercising with active modes (cycling/walking) during leisure time can positively contribute to health, the extent to which significant differences between years is investigated. As seen in Table 2, proportionally more people in all groups achieved ⩾ 150 minutes of active travel in their leisure time in a week in 2020 and 2021. On the intrapersonal level, the changes are significant for men, women, workers and people with high economic status (2019-2020 and 2019-2021).

Table 3. Individual changes in leisure-related travel; significant differences between the years are tested by paired t-test and are indicated in bolt

		number of leisure trips /week				share leisure trips /all trips [%]				≥ 150 min. active travel[1], all leisure trips in a week			
		2019- 2020		2019-2021		2019- 2020		2019-2021		2019- 2020		2019-2021	
		t	p	t	p	t	p	t	p	t	p	t	p
	Total	3.46	**0.001**	1.85	0.065	0.9	0.366	-0.98	0.330	-5.25	**<.001**	-5.33	**<.001**
Gender	Male	2.04	**0.042**	1.14	0.256	0.79	0.431	-0.94	0.348	-2.02	**0.044**	-2.41	**0.017**
	Female	2.91	**0.004**	1.47	0.143	0.48	0.629	-0.43	0.665	-5.56	**<.001**	-5.27	**<.001**
Occupation status	Worker	1.68	0.095	0.45	0.651	-1.07	0.284	-1.71	0.088	-4.73	**<.001**	-5.77	**<.001**
	In education	2.23	**0.030**	2.19	0.032	0.77	0.447	1.25	0.215	-1.43	0.159	-0.44	0.659
	Retired	2.66	**0.008**	1.34	0.181	2.23	**0.026**	0.05	0.962	-1.76	0.080	-1.74	0.083
	Other	0.18	0.859	0.12	0.903	-0.99	0.328	-1.45	0.156	-2.67	**0.012**	-1.68	0.103
Economic status	Low	0.98	0.334	0.49	0.625	0.93	0.358	-0.88	0.383	-1.00	0.324	-1.14	0.262
	Medium	2.99	**0.003**	1.82	0.070	1.16	0.246	0.82	0.414	-2.15	**0.032**	-0.82	0.415
	High	1.92	0.056	0.47	0.641	-0.07	0.944	-1.78	0.076	-4.93	**<.001**	-6.15	**<.001**

Significant changes (p<.05) between the years are marked in bold | [1] active travel= walking and/or cycling

4.4.4. Relationships between sociodemographic characteristics and changes in leisure travel

In this section, the outcome of the linear regression models is described. The dependent variable is positive if an individual reported more trips with leisure purposes in 2021 than in 2019. Unexpectedly, after running several different linear regression models we identified only few characteristics with significant influence on the difference in the number of leisure activities between 2019 and 2021. Model 1 in Table 4 shows that persons living in households with only one or two household members were more likely to increase their number of trips for leisure purposes during the pandemic. Model 2 reveals that persons living in households without children were more likely to increase their leisure trips than persons with children in the household. Further, a low or medium educational level is related to a decrease in the number of trips in 2021 compared to 2019 (Table 4 – Model 2).

However, the overall goodness-of-fit of all performed models, that were iteratively built including various sociodemographic characteristics such as gender, age and income, was insufficient (R-Square at 0.1 or lower). The explanatory power of the calculated regression models is therefore limited. Thus we decided to shed light on why we could not explain the existing variance with the sociodemographic characteristics in our data in the following analyses.

Table 4. Results of two selected linear regression models with the difference in the number of leisure activities between 2019 and 2021 as dependent variable and sociodemographic characteristics as independent variables

		Dependent variable: Difference in the number of leisure activities between 2019 and 2021 (positive = increase in leisure trips)	
Model	**Independent variables**	**Estimate**	**Pr > |t|**
Model 1	Intercept	-0.3602	0.1867
	Low or medium educational level	-0.4231	0.0951
	High educational level	Reference	
	One person in household	0.4187	0.2393
	Two persons in household	0.6805	0.0162
	Three or more persons in household	Reference	
Model 2	Intercept	-0.4793	0.1429
	Low or medium educational level	-0.4596	0.0706
	High educational level	Reference	
	Household without child(ren)	0.6770	0.0385
	Household with child(ren)	Reference	

4.4.5. Changes in leisure travel on the individual level

As described above, leisure activities are somewhat variable in their frequency from week to week and also from year to year. As we could not find a systematic explanation for the change in the number of leisure activities with our model, we analyzed the variability for these activities. Therefore, the standard deviation of the number of leisure activities in the three years are examined on the individual level: The mean standard deviation of all 754 participants of cohort 2019 reporting in 2019, 2020 and 2021 is 1.857. As a comparison, the mean standard deviation in the number of leisure activities for individuals reported in 2017, 2018 and 2019 is 1.886. This is surprisingly higher than the value for the individuals we observed for the cohort 2019 (during COVID-19). We expected that the hard-hitting experience of the pandemic results in more remarkable changes in the number of leisure activities than in a COVID-19-independent period. A t-test showed that the mean standard deviations were not significantly different. Overall, no differences were identified in the changes in the number of leisure activities per week between years with and without the COVID-19 pandemic.

4.4.6. Intra- and interpersonal variability in leisure trips

In contrast to expectations, the intra- and interpersonal differences in leisure days per week did not differ significantly when comparing the 2016 and 2017 cohorts to the 2019 cohort. This might be due to two different reasons. First, leisure activities are variable; therefore, the pandemic's impact did not significantly influence general variability. This theory is supported by the fact that the intra- and interpersonal differences of the 2019 cohort are generally on a similar level when compared to the reference cohorts. Still, the differences in leisure days per week vary strongly within the sociodemographic groups among all three observed cohorts.

Another reason might be that the variability went down simultaneously with an overall reduced level of leisure days per week. Therefore, no specific sociodemographic group reduced its leisure activities more than the others, resulting in similar intra- and interpersonal variabilities.

5. Discussion

The results show that more time is spent at home during the pandemic (Figure 3). The findings indicate that people organize their free time differently than before the pandemic. Evidence for this is also found by Mesaric et al. (2022). The study shows that people did not immediately return to their old behavior but adapted to the situation and more or less maintained this behavior in 2020 and 2021.

It is important to acknowledge that the containment measures implemented encompassed more than just the closure of educational institutions and recreational facilities. They also entailed the cancellation of public gatherings and the imposition of restrictions on the size of social gatherings. Consequently, individuals adopted varying strategies at the personal level to adapt to these measures. Some refrained from leaving their homes due to the fear of contracting the virus, while others engaged in alternative activities. Moreover, the specific measures have undergone changes throughout the years under examination, which makes direct comparisons of leisure-related travel modifications challenging. Figure 1 illustrates these changes, highlighting that in 2021, individuals possessing a vaccination certificate were granted permission to participate in numerous leisure activities that were prohibited during the same period in 2020 (such as engaging in team sports at the gym). However, unvaccinated individuals in 2021 were still unable to resume certain activities that vaccinated individuals were allowed to engage in (e.g., attending concerts).

Overall, no clear picture can be drawn based on the presented results of the changes in leisure-related travel. This indicates, to some extent, that some people started to adapt and maintain their new behavior while others went back to old routines. In addition, the behavior was likely adapted to the legal regulations, which were very restrictive in the period under consideration. We see slight indications that retired people, in particular, have restricted their leisure travel more than workers. For retirees, both relative and absolute leisure travel decreased between 2019 and 2021. In contrast, the absolute leisure travel decreased for workers while the relative leisure travel increased between 2019 and 2021.We conclude, that retired people restricted themselves more or differently than workers in the second year of the pandemic. One reason might be the higher probability of becoming severely ill with COVID-19.

In absolute terms of out-of-home leisure activities, we see that more loop trips are made and more people achieve $\geq$ 150 minutes of active travel, which was also found in McElroy et al. (2023). Since loop trips are often made for leisure purposes, our results suggest that outdoor leisure activities are highly valued during the pandemic, which was also found by Bohman et al. (2021). Compared to before, people do not necessarily visit out-of-home locations or do out-of-home activities such as going to gyms or restaurants. One possible explanation is the fear of becoming infected or spreading the virus while not knowing of being infected.

Our study shows that walking and cycling for daily trips can serve as a source of physical activity (besides sports at the gym or outdoors). Especially during the pandemic, this type of activity gained additional attention because gyms were partly closed. Our study shows increased ICT use (Table 1) on the one hand. This is especially true for younger people. ICT use increased least among pensioners during COVID-19. On the other hand people spent spent more time outside, thus reaching $\geq$ 150 min. active travel as recommended by the WHO (2010). However, Buehler et al. (2019) found that the distance of leisure destinations from the place of residence has a significant impact under non-pandemic conditions. Governments at different levels should promote walking and cycling to make citizens more resilient towards deficits in physical activities.

The presented study could not find a statistical indication that certain sociodemographic characteristics influence the change in leisure travel. Furthermore, the analyses could not find any system in the change of inter- and intrapersonal variance for leisure trips. We know that many people in 2020 and 2021 could not organize their leisure time in the way they were used to in previous years. However, based on the results, we can see no evidence that the variation within or between individuals has significantly changed. From a statistical perspective, the leisure activity-related indicators seem random and arbitrary. On the intrapersonal level, the changes are significant for men, women, workers and people with high economic status (2019-2020 and 2019-2021, Table 3). However, no significant differences can be identified between 2020 and 2021. Nevertheless, the decision to behave the way they do will certainly have had good reasons in reality. For example, Tsourus et al. (2021) found that relaxed, anxious, and cautious people differed in time spent, type of activities, and travel behavior during the pandemic. Especially in the leisure area, people can behave in a way that corresponds to their feelings, whereas at work or shopping, they are somewhat subject to constraint. However, for such a detailed analysis involving the feelings, the MOP data is insufficient.

Although our study can make statements about changes in leisure travel, there are shortcomings: First, we used data from a national household travel survey and no time-use data for the analyses. Since the focus in this type of data is trip based, the information on time use between trips is very rough. For example, many activities that take place at home, such as cooking or gardening, which for many are also considered as leisure activities, are not recorded in the travel diary. Furthermore, this study cannot give representative information about the German population based on the analyzed data due to the limited sample size. In addition, the study does not ask psychological questions about values and attitudes that might otherwise help explain the changes in behavior.

6. Conclusion

This study presents a comprehensive overview of changed activity and travel patterns during the first two years of the COVID-19 pandemic. Measures to stop the virus's spread have impacted travel patterns and time use in everyday life.

The German National Household Travel Survey MOP was used for the analysis. It contains a one-week trip diary to capture both intra- and interpersonal facets of changes in everyday travel and trip purposes. As the survey is based on a panel concept, it allows the study of intrapersonal changes in behavior during COVID-19, which means that the same participants reported in several years (before and during COVID-19). The focus of the study was to describe the impacts of the COVID-19 pandemic across leisure activities and establish the initial trends of changes and its potential to become a part of the new normality. The focus was on leisure travel because this part of mobility is seen as kind of flexible (in terms of time and place) and thus could be adapted most easily to the pandemic situation.

The findings indicate that the COVID-19 pandemic has had a significant impact on leisure travel. However, it is impossible to draw definitive conclusions regarding the persistence of the observed changes. Nonetheless, notable distinctions between the years 2020 and 2021 compared to 2019 are apparent. These results suggest the emergence of a "new normal" characterized by the partial abandonment of previous travel patterns and the adoption of new ones. Furthermore, the study offers insights into the rapidity with which behaviors can undergo transformation. Consequently, this information can assist policymakers in implementing appropriate measures during times of emergency. Lastly, our research demonstrates that leisure travel exhibits considerable variability across different years, making it challenging to identify statistically reliable patterns.

Further analyses and data are needed to better understand which changes in leisure activities will persist after the COVID-19 pandemic. In addition, the degree of persistence of individual behavior in the next several years needs to be examined to determine if the new or different activities (at home) will persist as a new routine or if a similar state to pre-pandemic will occur.

The pandemic has taught us that leisure time and its design are fundamental to well-being and health and outdoor activities play an important role in this - as long as preventive measures allow it. The analyses can help policymakers and planners design the environment so that the built environment and people are less vulnerable to future pandemics/epidemics.

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Author Contributions

The authors confirm contribution to the paper as follows: study conception and design: Lisa Ecke, Jan Vallée, Miriam Magdolen, Lukas Burger; data analysis: Lisa Ecke, Jan Vallée, Miriam Magdolen; interpretation of results: Lisa Ecke, Jan Vallée, Miriam Magdolen, Lukas Burger, Bastian Chlond, Peter Vortisch; draft manuscript preparation: Lisa Ecke, Jan Vallée, Miriam Magdolen, Lukas Burger; All authors reviewed the results and approved the final version of the manuscript.

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