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Activity and Mobility Patterns of a Diverse Group

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Accessibility in rural Austrian areas is more restricted than in urban regions. Limited accessibility leads to social exclusion. Therefore, mobility should be inclusive, allowing everyone to satisfy mobility needs and reach destinations. Mobility should also be environmentally friendly. Use of a private car offers opportunities for comprehensive mobility but is related with high individual, social, and environmental costs. We studied the interplay between employment, care, and mobility variables among people in the foothills of the European Alps in Lower Austria who are employed and have care responsibilities, assuming them to be a group with complex mobility needs and high vulnerability. The aim was to derive policy recommendations to decrease their car dependency and ensure accessibility. Adopting a mixed methods approach, we conducted a tailored quantitative and qualitative survey, using cluster analysis to derive relevant patterns. Within the group under analysis, 5 subgroups were identified: persons in 2 clusters worked more and cared less, with significant differences in commuting distances. Persons of 2 further clusters cared more and worked less, with one group caring for very young children, and the other working and caring a lot. Persons in the fifth cluster cared for elderly people, had low caring duties, and almost no pickup/drop-off trips; almost all had full-time jobs. Significant gender differences existed in the identified activity patterns. Results showed that responsibility for care is still mainly with women, even if they are increasingly seeking employment. Recommendations in 3 major fields of action were derived, comprising: measures to support the mobility of persons responsible for care, measures to support the autonomy of cared persons' mobility, and measures to reduce the mobility needs of both groups. Even if respondents are satisfied with how they manage their care tasks and employment by car, higher shares of walking, cycling, and public transport seem to be necessary and feasible.

Keywords: *Mobility; mountain region; care responsibilities; gender; social inclusion.*

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Introduction

Accessibility in rural Austrian areas is more restricted than in urban regions. Distances to facilities for everyday activities are longer, and destinations and spatial structures are often too dispersed for organizing efficient and dense public transport. Consequently, private cars are the dominant mode of transportation in these areas (Herry et al 2011). Access to a car seems to be essential for full participation in economic and social life (Lucas 2012). At the same time, rural areas—in particular in mountain regions—are mostly very sensitive natural habitats (Onida et al 2009; Agnoletti 2014), harboring a number of plants and animals likely to be affected by infrastructure and traffic. Rural landscapes are also very attractive for tourism, and in mountain regions, the tourism industry depends on the environmental quality of natural and cultural landscapes (Hall and Boyd 2005; Bell et al 2007).

In these regions, mobility should therefore be organized both as efficiently as possible and in an environmentally friendly way. The goal is to ensure high accessibility—a key prerequisite for successful economic development and for keeping young residents and attracting others—while at the same time preserving sensitive natural environments. Additionally, mobility should be inclusive and allow all groups of persons to satisfy their mobility needs and to reach their destinations (Social Exclusion Unit 2003; Gray et al 2006; Cebollada 2009; Bundesministerium für Verkehr, Bau und Stadtentwicklung 2012).

We conducted a study on the mobility needs of a specific group in a sensitive mountain region located at the eastern end of the European Alpine region and south of Vienna. The group we chose to focus on, working

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women and men with care responsibilities, has specifically challenging mobility needs. Persons in this group have to reach manifold destinations, need to coordinate with the persons they care for, face many time constraints such as opening hours of shops or daycare centers, and often travel together with other persons. Finding solutions that guarantee mobility suiting these persons' needs while also being efficient and respecting the environment is therefore especially relevant and challenging (Figure 1).

To the best of our knowledge, this is the first study specifically collecting data on working persons with care responsibilities in rural mountain areas, aiming to provide a detailed analysis of the male and female group members' characteristics, their mobility patterns, and their needs. The literature review presented in the following section shows that there is a dynamic development of gender differences in care, employment, and mobility: Women still work less than men, they have more care duties, and they have different mobility patterns. However, gender differences are decreasing (Schwanen 2007; Bundesministerin für Frauen und Öffentlichen Dienst im Bundeskanzleramt Österreich 2010; Scheiner 2013). The present paper presents the results of an analysis of a sample of 436 persons who were hypothesized as having highly dynamic activity patterns—women and men who perform care duties and work in a rural mountain region.

The aim of this paper is to analyze the interplay among gender, care, employment, and mobility, and thus to understand how working women and men with care responsibilities organize their daily lives. To this purpose, the following research questions were formulated:

1. What typical patterns in employment, care, and mobility exist within the group under analysis?
2. Are patterns significantly different between men and women?
3. What measures are suitable to both supporting daily mobility of working men and women with care responsibilities and reducing the environmental impact of their mobility?

Literature on mobility of women and men with care responsibilities

Literature on activity and mobility patterns of people with care responsibilities in rural mountain areas in Austria and other European Alpine countries is rare. We report here on insights gained from the literature we found on individual aspects of the topic: care and employment patterns, and mobility with a focus on rural areas. Sources on gender differences in mobility and activity patterns are prominently included, as people with care responsibilities are still mostly women.

Care and employment patterns consistently show significant differences between men and women in the literature (Bauhardt 2007; Duchène 2011; Larcher et al 2014): 87.3% of Austrian women and 6.4% men stop working upon birth of a child; 51.2% of women and 5.4% of men with children under 8 years reduce their weekly working hours for performing childcare. The unequal distribution of paid and unpaid work between men and women has significant negative effects on women's income (Statistik Austria 2011). Neuwirth and Wernhart (2007) show that most Austrian women resume their professional activity when the youngest child is between 1 and 2 years of age; the share of employed women is 64% when the youngest child is 2 years old. The share of part-time employment remains high for women when children get older, and it is still 43.1% when children younger than 15 years are living in the household (for men: only 4%) (Statistik Austria 2011). For the whole of Austria, Statistik Austria (2011) shows an increase in employment of women with children. Between 1994 and 2010, the share of employed women with children aged 3 to 6 increased from 55% to 70%. About 81% of women with their youngest child aged 6 to 15 years were employed in 2010. Scheiner (2013) shows comparable developments for Germany. However, even if women spend more time in employment, the time budgets for women's household work remain almost constant (Schwanen 2007; Uteng and Cresswell 2008; Hanson 2010). Neuwirth and Wernhart (2007) found that women are more likely to work when they are single mothers, when they have a higher education, and when daycare facilities are available. Women are less likely to work when they have a migration background and the more children they have.

Literature on gender differences in mobility reports less travel distances, more daily trips, more trip chains, and more pickup/drop-off trips for women compared to men (DfT 2007; Rosenbloom 2006; Uteng and Cresswell 2008; Infas and DLR 2010; Duchène 2011). The spatial range of women's daily mobility is reported to be smaller than for men. Women work closer to home, they drive fewer miles per day, they are more likely to work at home, and they are less engaged in business overnight trips and extreme commuting (Dobbs 2005; Crane and Takahashi 2009; Hanson 2010). ÖROK (2010) found lower daily travel times, less car trips, but more walking trips for Austrian women, with an increasing percentage of car trips from 1995 to 2005. Best and Lanzendorf (2005) report significantly more shopping trips by women and less trips for commuting and education by the same group. This effect increases when children live in the households under analysis. The literature also shows that women's mobility patterns have become more similar to men's in the last few years: Women work more, household roles are changing, and the percentage of nontraditional households and families is increasing (Best and Lanzendorf 2005; Rosenbloom 2006).

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FIGURE 1 Regular train services support autonomous travelling of cared persons. Pfennigbach Station, Lower Austria. (Photo by Nikolaus Bellos)

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FIGURE 2 Map of Austria with federal states (black lines) and survey area (red line). (Sources: CC_BY_3.0; Land Kärnten – data.gv.at, US Geological Survey; map by Franz Suppan and Sarah-Kay Schotte)

Næss (2006) analyzes the influence of spatial structures on mobility (see also van Wee et al 2006; Osti 2010; Hine et al 2012). Travelled distances in rural areas are longer than in urban areas, especially for commuting trips, but travel times are similar to those reported in agglomerations, thanks to higher speed (see also Infas and DLR 2010). Trip frequency is higher on weekdays in rural areas but lower on weekend days compared to urban areas. Daily travel time in urban areas is shorter on weekdays compared to rural areas but longer on weekend days. Whether local nearby facilities are used in rural areas strongly depends on the existence of competition from nonlocal facilities. Car use and car ownership are significantly higher in rural areas compared to urban regions.

Methods

To answer our research questions, we conducted a survey-based quantitative analysis, designed on the basis of a literature review, and qualitative interviews on mobility and gender roles in households conducted in early 2013. The quantitative survey was conducted in early summer 2013 and was complemented by a series of 6 workshops in 2013 and 2014, in which representatives of regions and communities, public transport providers, representatives of schools, and private persons exchanged their views on the current situation and discussed fields of action for improving their mobility situation. Insights from the quantitative survey were validated by statements made by workshop participants. These statements also helped to interpret the quantitative results.

We did a univariate analysis of descriptive measures separately for care, employment, and mobility. In a second step, we applied cluster analysis. The goal of this modelling exercise was to disentangle the effects observed using descriptive statistics and to identify typical subgroups with regard to variables in all the 3 dimensions. Recommendations were developed specifically for the individual clusters based on the hypothesis that targeted measures are needed in order to be actually used and effective. Differences between men and women were analyzed at all stages of the analysis to answer research question 2.

Study area

Our study site is situated in the mountainous area of the Austrian Federal State of Lower Austria: It is located in the eastern foothills of the European Alps, where they meet the Pannonian lowlands to the south of Austria's capital city, Vienna (Figure 2). In the European context, the area is classified as a Regional Competitiveness and Employment Region, where environment and risk prevention, use of clean technology in public transport, tourism development, and access to transport and telecommunications services are of general economic interest (European Commission 2006). The survey region has 62,752 inhabitants (Statistik Austria 2013) and a 4% share of agricultural employment (Statistik Austria 2009; see Unbehaun et al [2014] for more information on the study area).

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The survey area is structured by 2 parallel valleys of the southern expansions of the Vienna Forest (Wiener Wald) and the northeastern foothills of the Schneeberg Mountain. It covers 30 communities in 4 districts and 2 regions called Triestingtal and Schneebergland. The survey area covers the polygon with the geographical coordinates north: 48°3′27.781″N, 15°54′10.012″E; east: 47°55′11.255″N, 16°12′25.952″E; west: 47°52′42.931″N, 15°38′15.389″E; south: 47°44′29.929″N, 15°54′34.949″E. Population density is higher in the eastern parts of the survey area (up to 500 inhabitants per km^2) and decreases to less than 15 inhabitants per km^2 in the western parts (Statistik Austria 2013).

Many communities in the west and south of the area suffer from poor local public infrastructure. Communities in the north, east, and southeast benefit from the proximity of the motorway and railway, with direct connections to the major cities of Vienna, Baden, Wiener Neustadt, and Neunkirchen. Population development in the overall study area is positive (plus 3.9% per year, compared to 4.6% as Lower Austria state average), with large differences in growth rates. The population in communities near major transport infrastructure and within the greater area of Vienna increased by up to 21% between 2001 and 2009, whereas population in the smaller communities in the mountainous western parts of the area decreased by up to minus 11% in the same period (Statistik Austria, 2012).

Data collection

Stratified sampling was necessary to recruit the respondents. A random sample of 6820 household addresses in the study area was drawn from the panel of the Austrian Postal company, half of them households with at least one child aged 0 to 14 years, and half of them without further information. Phone numbers were found for 3625 households. Of these, 2281 households were contacted, and 827 could not be reached (no valid address or incomplete interviews, eg due to language problems). In total, 557 persons refused to be interviewed, 503 persons did not belong to the target group, and 475 interviews were completed; 436 interviews were left after having completed data processing and plausibility checks.

A telephone survey was chosen for data collection for the following reasons: It allows for long interviews of about 30 minutes, and for semistandardized questions collecting information (eg on suggestions for mobility services). It also allows the quality and completeness of answers to be controlled directly during the interviews. Higher response rates can be achieved by telephone surveys compared to written surveys, as people are recruited through direct oral and personal contact. Compared to written surveys, people are more willing to participate in long and complex telephone interviews (Fellendorf et al. 2011). The unit of survey was the individual person; we did not aim at interviewing complete households, which is much more challenging by phone compared to written surveys.

Target groups were women and men with care responsibilities for children aged below 15 years, disabled persons, or elderly persons. The respondents also had to either be actively engaged in a job or as a student, or they had to be interested in getting a job or beginning some training to be included in the sample. We explicitly included men and women in our sample in order to enable us to analyze gender differences within the group.

The first part of the telephone interview (screening) served to identify whether the interviewee belonged to the target group. With target persons, the complete interview was conducted, including questions on the household and personal attributes concerning care, employment, and the availability of transport modes as well as a one-day trip diary. The trip diary was designed according to the traditional design used throughout Europe for mobility surveys, with slight adaptions to better include gender issues (Knoll 2008; Fellendorf et al. 2011).

Statistical analysis

Besides descriptive statistics, cluster analysis was chosen for analyzing the formulated research questions. This multivariate method is designed for problems without a clear distinction between dependent variables and covariates. It is suitable to identify typical patterns in a range of variables. In our case, these were variables on care, employment, and mobility.

Variables used for clustering (Figure 3) were standardized, and the Euclidean distance between observations was calculated. Standardization of variables was necessary because of the different ranges and units, such as kilometers for distances, hours for work per week, or years for age; this is also a textbook data preprocessing method for cluster analysis (eg Kaufman and Rousseeuw 1990; Everitt et al 2011). The resulting distance matrix was clustered using Ward's hierarchical linkage method (Ward 1963). The number of clusters was determined by cutting the resulting dendrogram at different levels and keeping the partition that was most interesting for our analysis. Other linkage methods, such as complete linkage or average linkage, were also tried but yielded inferior results. Significant differences between clusters in metric background variables were tested using one-way analysis of variance (ANOVA). Differences in categorical background variables were checked using chi square tests (Greene and D'Oliveira 2011). These tests were also applied for testing gender differences in descriptive measures.

Results and discussion

Sample characteristics

Table 1 provides an overview of the sample characteristics, where 51% of the inhabitants in the

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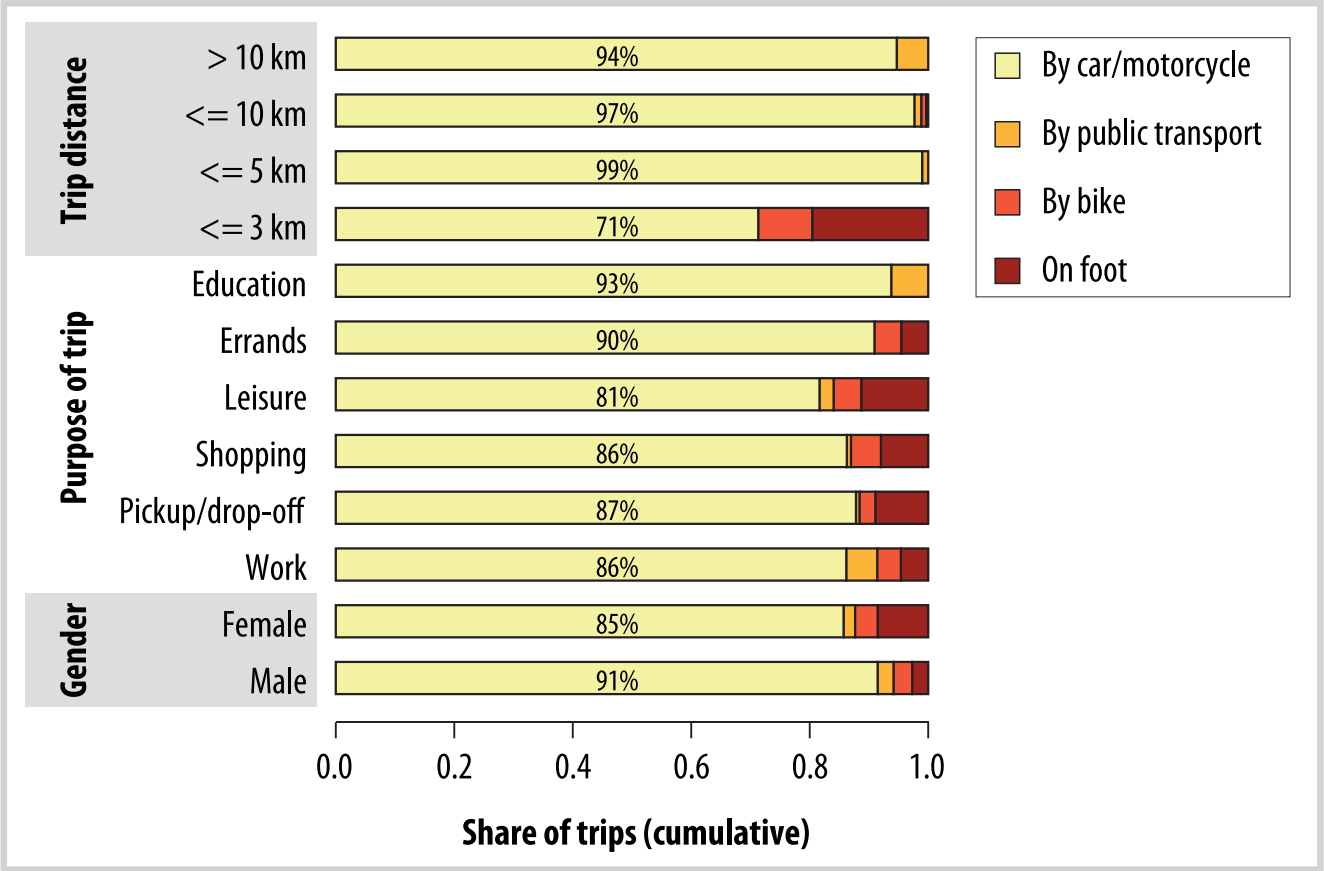
FIGURE 3 Modal split by trip purpose, trip distance, and gender.



survey area were female and 50% were male, compared to a share of 77% women and 23% men in the sample. With 42.1 years, the mean age of the respondents was rather high. The reason for this seems to be the sampling criteria (either be in a job or be a student, or wish to begin either). Parents with very young children below 5 years probably more often do not wish to work but are just fine to be at home with the children. In our survey, 49% of the respondents in the sample had a high school degree (*Matura*) or higher, compared to 34% in the overall population (AK NÖ 2013). With 87%, the share of persons employed was higher than the average in Lower Austria state (73%; AK NÖ 2013), which was also due to the sampling criteria. In our sample, 98% of men and 83% of women were employed (Lower Austria: men: 79%, women: 68%). Compared to the average in Lower Austria with 7% (AK NÖ 2013), the share of single parents was slightly higher (8%). These differences confirm findings that women are more likely to work when they are single mothers and when they have a higher education (Neuwirth and Wernhart 2007).

The mean age of children to be cared for in our sample was higher compared to the overall survey area mean: 9222 children aged below 15 lived there, with a share of 30% for children below 5 years, 34% for children from 5 to 9, and 35% for children between 10 and 14 years. In our sample, only 19% of the children under care were below 5 years. This group was underrepresented, to the benefit of the age group between 10 and 14 years (45%). In total, the respondents took care of 803 persons; 89% of these were their own children, 7.0% were grandchildren or other people's children, and 4.2% were persons aged above 14 years. The average household size was 3.9 persons. Persons were in charge of caring for 1.7 persons on average (standard deviation 0.8). Respondents who cared for persons older than 14 years were mostly responsible for 1 person.

Descriptive statistics on patterns of care, work, and mobility

Consistent with the literature, women in our sample were more engaged in care than men (Scheiner 2013). Differences between men and women's involvement in care were significant for all analyzed variables at the 5% level. A total of 74% of the women interviewed said they were solely in charge of care (women: 37%, men: 6%) or of care with some support (women: 37%, men: 12%), compared to 18% of the interviewed men. Women stated that they were busy with care activities for 8.7 hours a day

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TABLE 1 Sample description; for each variable, the total number of respondents is given in brackets. (Table 1 Continued on next page.)

Variable		Percent respondents
Gender ($n = 436$)	Male	23
	Female	77
Age ($n = 434$)	<18	0
	18–29	5
	30–34	9
	35–39	21
	40–44	25
	45–49	24
	50–64	15
	65+	0
Education ($n = 245$)[a)]	No school-leaving certificate	1
	Primary school	3
	Vocational training	38
	Secondary without degree	8
	Secondary with degree	22
	Training college	8
	University	19
	Other	1
Family status ($n = 434$)	Married	76
	Cohabitee	8
	Divorced	7
	Living separately	1
	Single	8
	Widowed	1
Employment status ($n = 436$)	None	10
	Employed	87
	Student	2
	Both	1
Number of persons per household ($n = 435$)	1	0
	2	6
	3	26
	4	44
	5	15
	>5	8

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TABLE 1 Continued. (First part of Table 1 on previous page.)

Variable		Percent respondents
Number of persons with a job per household ($n = 433$)	0	1
	1	23
	2	70
	>2	6
Number of children per household ($n = 435$)	0	5
	1	36
	2	44
	3	13
	4	1
Net equivalent income (OECD) per household ($n = 405$)	<500 EUR (676 USD)	36
	≤1000 EUR (1352 USD)	15
	≤1500 EUR (2028 USD)	22
	≤2000 EUR (2704 USD)	20
	>2000 EUR (2704 USD)	8

[a)]Due to technical problems with the Computer Assisted Telephone Interview-System (CATI-system), we were only able to use information about the education variable for the last 245 respondents.

on average, while men mentioned a total of 4.4 hours. Care involvement throughout the day was reported by 16% of women and 5% of men. The main care periods for men and women were the afternoon and the evening, with 64% of respondents reporting care activities during these times.

Differences between women and men in weekly working hours were significant, with 28 hours per week for women and 45 hours per week for men on average. While 82% men reported 40 or more hours per week, only 22% women did so. Also, 34% women worked under their qualification level (men: 15%). The correlation between the degree of care involvement and employment is significant (−0.35**).

A share of 97% of the respondents had a car driving license. The average number of cars per household was 1.9, so 93% of respondents stated always being able to use a car, with no significant difference between women and men. Less than 1% had no access to a car at all. These 4 persons were all women.

Travel distances to the workplace of 35% respondents amounted to less than 5 km (men: 31%, women: 36%); 35% respondents reported over 20 km (men: 43%, women: 32%), but differences between men and women are not significant for this variable. The average travel time to work was 23 minutes, with no significant difference between women and men. The private car was the transport mode that was used regularly by most persons for their work trips (62%), and 71% women and 68% men used a car for their regular work trips. Trains for regular commuting were used by 22% respondents (similar for men and women), and 4.4% respondents cycled to work (men: 7.0%, women: 4.2%). Buses and walking were used least for work trips, with 0.7% and 1.6%, respectively. Differences in choice of mode for travelling to work between women and men are not significant.

In addition to this general information on travel pattern to work, we collected complete trip data for one diary-day, with at least one pickup/drop-off and/or one working trip including trip times, distances, location of origin and destination, mode, and purpose. With 4.6 trips per day, the mean number of trips was significantly higher than the average in Lower Austria state (Herry et al 2011). On average, men reported a lower number of trips per day (3.9) than women (4.8), but this difference is not significant due to high standard deviations in both groups. Compared to the average length of working trips of 20.1 km in the trip diary, the mean distance per trip of 12.8 km indicates a high number of short, non-work-related trips. Trip distances of women (11.5 km) were significantly lower than of men (17.9 km). With 40%, the share of pickup/drop-off trips was high, with significant differences between men and women. Men reported on average 1.1 pickup/drop-off trip; women reported 2.1. With a mean distance of 3.0 km, these trips were comparably short. Mean distances of pickup/drop-off trips of men were shorter than for women, but not significantly. With 83 minutes per day, men had longer daily travel times than women (80 minutes), but this

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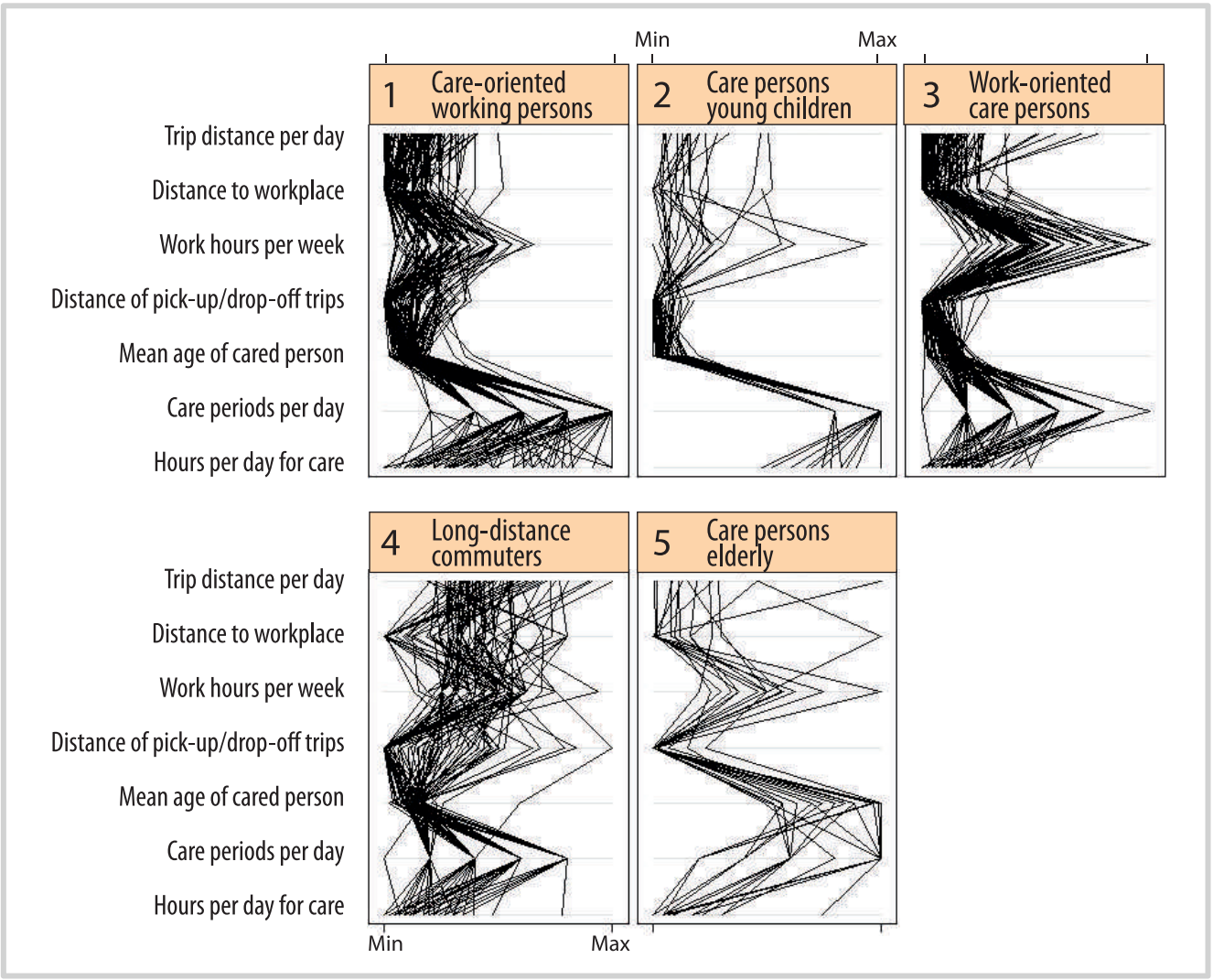
FIGURE 4 Parallel plot visualizing the values of the variables per cluster.



difference is not significant. These findings are in line with literature reported previously (Dobbs 2005; Crane and Takahashi 2009; Hanson 2010; Scheiner 2013).

Considering all daily trips, the private car was the main mode of transport, with 83% of all trips. Figure 3 gives an overview of the modal split along the sex, trip distance, and purpose variables. The share of car trips is consistently high, with 70% of trips ≤3 km done by car. The share of train trips was highest for education-related trips (6%) and for trips ≥10 km (5%).

The descriptive results also provide a first picture of activity patterns. They reveal significant differences between women and men for many variables. Building on these descriptive analyses, we identified subgroups of persons with typical activity patterns related to employment, care, and mobility variables. The aim of this step was to better understand the composition of the groups under analysis and to develop group-specific suggestions for improved mobility services in the penultimate section of this paper.

Clustering persons with typical activity patterns

The size of the clusters and the magnitude and variance of the individual variables are visualized in Figure 4. The mean values and standard deviations of the variables are listed in Table 2. We included variables from all 3 types of activity: care (number of care periods per day, number of hours spent for care per day, mean age of cared persons), employment (work hours per week), and mobility (overall daily trip distance in km, distance to the workplace in km, and distance for pickup/drop-off trips in km). We included the most important variables directly into the cluster analysis and tested for differences in additional variables (eg gender) between the clusters in a second step. Only travel distances were included for describing

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mobility patterns in the clusters, as these are highly correlated with travel times.

The cluster analysis grouped respondents into 5 clusters of different size. Partitions with higher or lower numbers of clusters yielded inferior results. Figure 4 shows the clusters in a parallel coordinate display. Each vertical polyline corresponds to one person. Variables are scaled independently so that the observed minimum is leftmost and maximum is rightmost; for example, polylines starting top left in each panel correspond to persons with the shortest trip distance per day, and polylines starting top right correspond to persons with the longest trip time, etc.

The two main "working clusters" are cluster 3, "work-oriented care persons," and cluster 4, "long-distance commuters." These clusters contain significantly fewer women than men; they worked on average 35 hours per week and reported 2 care periods per day, mainly the morning and the evening. In these clusters, there were significantly fewer respondents who were sole carers or caring with some support, compared to the "care clusters" described below. They shared the care responsibility with somebody else and had a lower share of care responsibility. The main difference between both clusters is the distance to the work place, with implications also for the length of pickup/drop-off trips, which is significantly longer in cluster 4 with "long-distance commuters" compared to cluster 3. The comparably low care responsibilities of persons in clusters 3 and 4 do not lead to significant differences between all clusters, either in the overall number of trips or in the number of pickup/drop-off trips. Partners in households seem to share the responsibility of accompanying cared persons on trips more equally than they share care tasks themselves. Care tasks often remain in the responsibility of one partner—usually women. Clusters 3 and 4 have the highest share of train trips (24% and 26%) in their modal split. Trains were mainly used for trips to and from work.

Cluster 1 with "care-oriented working persons" and cluster 2 with "care persons young children" are the two main "care clusters." Persons in cluster 2 were mainly caring for very young children. At 5 years, the mean age of the cared person is significantly lower than in all other clusters. At 18 hours per week, persons in cluster 2 had the lowest weekly working time combined with care throughout the day, with 5 care periods on average. Compared with this cluster, persons in cluster 1 were much more engaged in work and care activities, with 30 working hours per week and 10 hours for care per day on average. In total, they spent more time than all other clusters for care, employment, and trips. The car seemed to be necessary to manage the high workload related to employment and care (especially cluster 1) and to care for very young children who did not move on their own nor stayed alone, and thus were accompanied by the adults on many trips (cluster 2). Compared to all other clusters, persons in clusters 1 and 2 held the highest share of car trips, with 78% and 83% of all trips, respectively.

Cluster 5, "care persons elderly," contains respondents who cared for elderly people. With 18 observations, this cluster is small, but it was consistently a separate cluster in our tests and is expected to grow in the future. Indeed, demographic development shows that the number of people caring for the elderly is likely to rise in the coming years. People in this cluster reported the highest number of weekly working hours and comparably long trips to work. They had only few pickup/drop-off trips and were hardly ever accompanied by the persons they cared for.

Figure 5 shows the size of the clusters and the share of men/women within the clusters in a mosaic display. Cell sizes correspond to the total number of persons in each cluster/gender combination. Cells with large Pearson residuals (deviation between observed and expected frequencies under independence) are marked in orange and red. Women still dominate the overall group of people with care responsibilities, and especially the clusters with persons who are mainly carers. There is no man in cluster 2, "care persons young children," whereas clusters 3, "work-oriented care persons," and 4, "long-distance commuters," have the highest share of men. We also tested for differences between the clusters with other variables. Household income was highest in the cluster with "long-distance commuters." Differences in the overall number of trips and in the number of pickup/drop-off trips are not as clear, probably because men and women who work and care more both take the children to and from their daycare facilities. Family arrangements for this task seem to be too diverse to show clear patterns in the cluster analysis.

Suggestions and preferences for measures

Asked about suggestions and preferences for measures that might help them to better manage everyday mobility, care tasks, and work, respondents and workshop participants requested support in all 3 dimensions: 43% of respondents from cluster 2, "care persons young children," stated that closer daycare facilities for children aged 0 years to primary school with whole-day opening hours would make their lives easier. With 29%, the share of respondents requesting such improved daycare facilities for young children was similar in clusters 1, "care-oriented working persons," and 3, "work-oriented care persons." Clusters 1 and 3 seem to be the partners: Cluster 1 cares more and works less with some support from cluster 3 consisting of the respondents who work more and care less. This supports insights gained from the cluster description in the Results and Discussion section. In our survey, 59% respondents in cluster 5, "care persons elderly," stated that daycare and caretaking services for the elderly would support their daily routines. This share was significantly higher than in all other clusters.

Extended shop opening hours and improved delivery services were only requested by few respondents. With

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TABLE 2 Mean values per cluster and variable; standard deviations are given in brackets. (Table 2 Extended on next page.)

Cluster	Description	Hours per day for care (h)	Care periods per day[a)]	Mean age of cared person	Distance of pickup/drop-off trips (km)
1	Care-oriented working persons	9.9 (5.2)	3.6 (0.9)	10.0 (5.1)	13.6 (17.3)
2	Care persons young children	20.5 (3.7)	4.9 (0.3)	4.9 (3.9)	5.6 (7.8)
3	Work-oriented care persons	4.2 (2.0)	1.8 (0.7)	10.9 (3.6)	3.5 (6.8)
4	Long-distance commuters	4.9 (2.7)	2.2 (0.9)	11.3 (5.4)	32.9 (36.8)
5	Care persons elderly	4.4 (4.0)	3.2 (1.5)	64.7 (15.4)	2.5 (6.5)

[a)]Respondents were asked for what periods of the day they usually have care duties (whole day, morning, before noon, noon, afternoon, evening, night). Values stand for the sum of indicated care periods per day.

regard to transport system measures, most of the respondents' suggestions focused on public transport: 47% of the respondents in the overall sample stated that life would be easier for them with better public transport services, with significant differences between the clusters. We found that 59% of the respondents in cluster 2, "care persons young children," and 58% in cluster 4, "long-distance commuters," answered this question with yes, whereas this share was lowest in cluster 3, "work-oriented care persons" (37%), and cluster 5, "care persons elderly" (33%). Respondents mainly wished to have more connections per hour, better coordination between the different public transport services, improved school bus services, and friendlier staff. Persons caring for older children in particular stated that they would benefit from improvements in public transport (ie if improvements allowed their children to travel more autonomously).

Recommendations

The analyses show that respondents were able to manage their daily lives including care tasks, jobs, and mobility. Is there any need for action? We see 2 main problems related to the observed activity patterns:

- Mobility is mainly car-based, with costs for individuals and the communities in the region, and negative environmental effects. Costs for individuals will probably increase further as fossil resources become scarcer. Persons with low wages (eg caused by part-time employment) will be particularly affected. Moreover, the studied region may be affected by loss of jobs and population.
- Children rarely travel on their own, with consequences for their parents' time budgets and children's mobility skills. Consequences for their future mobility behavior can be expected, as travel habits seem to be acquired in early years (Flade and Limbourg 1997; Scholl and Sydow 2002).

So we see a need for action both from an individual and societal perspective. The main objectives would be to decrease individuals' car dependency and ensure accessibility in mountain regions by offering flexible and locally adapted mobility choices for care and cared persons in order to keep the region attractive even if mobility costs increase. Efficient and environmentally friendly mobility also helps to preserve natural habitats in mountains. To meet the initially formulated goals of inclusive and environmentally friendly mobility patterns, we derived 3 major fields of action from the survey data and workshop discussions in the survey area:

1. Measures to support the mobility of persons responsible for care;
2. Measures to support the autonomous mobility of cared persons;
3. Measures to reduce the mobility needs of both groups.

Measures in fields 1 and 2 overlap for pickup/drop-off trips. Higher autonomy in mobility of cared persons would have the additional effect of decreasing the care persons' number of trips. Given the high share of pickup/drop-off trips shorter than 3 km (50%), our first recommendation is to improve and extend the infrastructure for walking and cycling and to promote these modes of transport.

Few sidewalks and cycling paths exist to date in the study area and generally in rural mountain communities in Austria. Existing cycling tracks have been planned to meet tourists' needs rather than residents' needs related to daily mobility. While lack of cycling tracks was unproblematic as long as there were fewer cars and these drove at lower speed, today this lack is a major obstacle to letting children move on their own. Children in the sample were old enough to travel on their own, but parents in the stakeholder workshops reported major concerns about traffic safety. Workshop participants also confirmed that settlements are mostly located in the valleys, and steep slopes were not a problem for most of the respondents' trips. Electric bicycles offer new advantages for cyclists in mountain areas, but infrastructure needs to follow standards for accessibility, connectivity, safety, and security. Travel-sharing opportunities such as *pedibus* (VCS 2014) exist in some of the communities. Promotion and knowledge sharing can help to extend such services and to increase their usage.

TABLE 2 Extended. (First part of Table 2 on previous page.)

Cluster	Description	Working hours per week (h)	Distance to workplace (km)	Trip distance per day (km)	Number of cases
1	Care-oriented working persons	29.7 (14.8)	11.8 (12.7)	41.1 (29.7)	132
2	Care persons young children	18.4 (17.2)	18.7 (19.7)	44.5 (34.8)	46
3	Work-oriented care persons	34.5 (15.1)	11.7 (12.2)	40.6 (39.8)	142
4	Long-distance commuters	35.4 (12.1)	42.1 (26.4)	111.4 (49.7)	89
5	Care persons elderly	39.1 (15.3)	18.8 (30.5)	58.9 (32.8)	18

The literature shows that targeted campaigns in schools and households significantly increase the percentage of children walking and cycling (Möser and Bamberg 2008).

Persons responsible for care can additionally be supported by improving alternatives for non-pickup/drop-off trips by car. Dense public transport services that meet the challenging demands of the groups of people we studied would not be affordable in these rural areas. Reliable and affordable public transport services on main connections are important and are already used by the persons in our sample for regular trips. Implementation of such transport services should be easier in rural mountain compared to rural non-mountain regions, as main settlements are located along the valleys and spread less throughout the area.

Workshop participants stressed the importance of affordable public transport prices also for nonregular users. Feeder systems to these main public transport lines

FIGURE 5 Mosaic plot visualizing the size of the clusters and the share of men and women within each cluster.

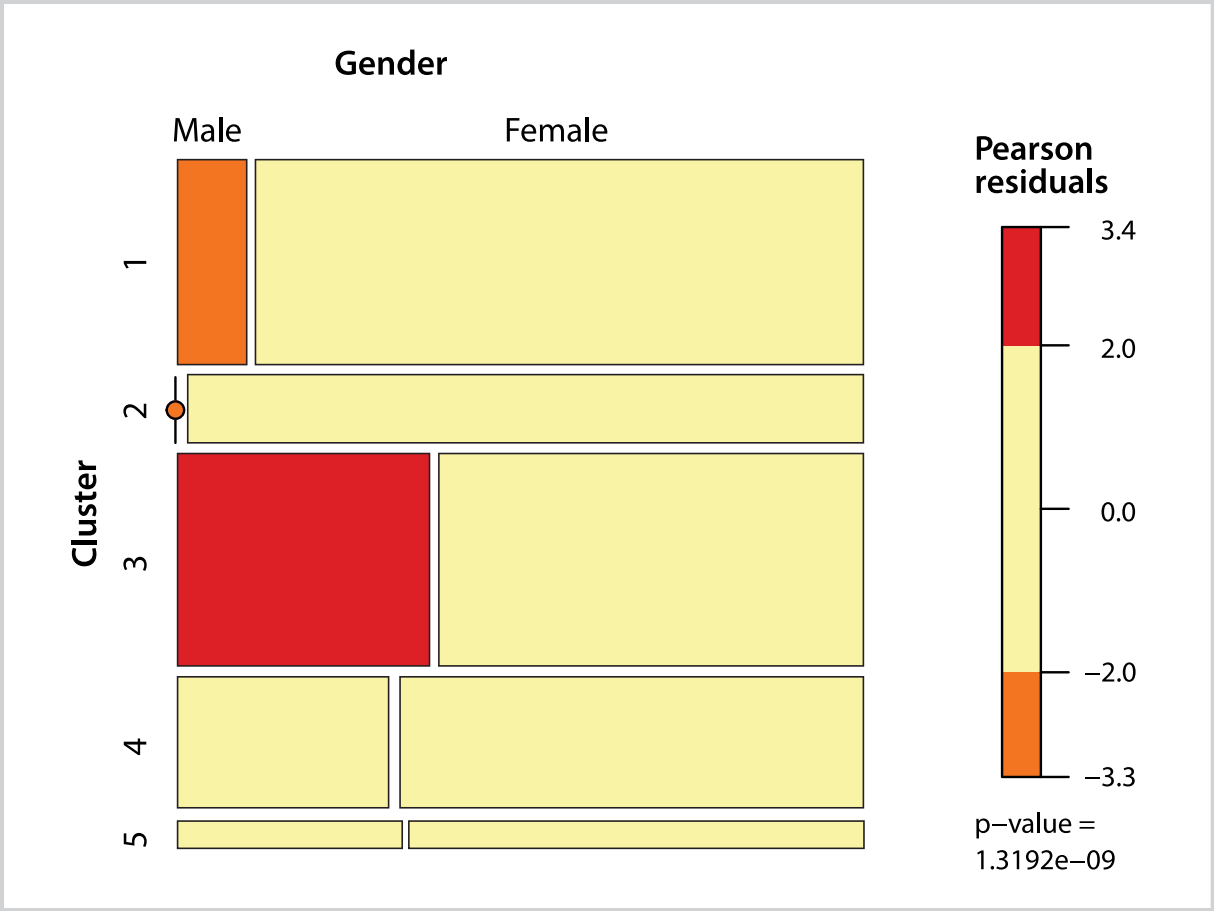

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TABLE 3 Cluster-specific and overall policy recommendations.

No.	Cluster description	Cluster characteristics	Cluster-specific measures	Groups of measures for all clusters
1	Care-oriented working persons	High care and high workload Highest difficulties in replacing the car as mode of transport	• Increase autonomous mobility of children, G1, G2 • Support for coordinating and sharing pickup/drop-off tasks in neighborhoods • Alternatives to car for regular work trips, G2 • Promotion and information on existing services, G3	G1. Shift of transport mode from short car trips to walking/cycling by providing and promoting high-quality walking and cycling infrastructure in the valley settlements G2. Alternatives to private car use, esp. for regular (mainly work) trips: reliable public transport on main connections, well-coordinated with small-scale, demand-driven, flexible feeder systems, Park & Ride facilities, Park & Drive facilities, reasonable prices also for irregular public transport users Support for private and public carpooling G3. Awareness of the benefits of reducing car use: communicate and promote health, environmental, economic benefits of alternatives to private car, eg through individualized marketing campaigns (Bamberg 2013)
2	Care persons young children	Less work, much care, young children	• Support for short distance mobility, G1 • Whole-day care facilities • (Location independent) Flexible part-time work	
3	Work-oriented care persons	Less care, much work, short- and medium-distance commuting trips	• Increase autonomous mobility of children, G1, G2 • Alternatives to car for regular work trips, G2 • Promotion and information on existing services, G3	
4	Long-distance commuters	Less care, much work, long-distance commuting trips		
5	Care persons elderly	Much work, less care for elderly, very few pickup/drop-off trips	• Alternatives to car for regular work trips like public transport and car-sharing measures, G2 • (Mobile) Day care for the elderly	

need to be constantly adapted to the changing local conditions and requirements. Our study area is a LEADER region (Agrar.Projekt.Verein 2014), implying that bottom-up private solutions such as carpooling or the coordination of pickup/drop-off activities can receive financial support.

Daycare facilities and schools are important locations to inform persons with care responsibilities about existing services and planned activities. Better information about existing services was one key wish expressed by workshop participants, in addition to the request for support for the organization of ride sharing.

The third field of action aims at reducing the mobility needs of both care and cared persons. This involves providing daycare facilities, flexible working times, and if possible the opportunity to work at home. In all stakeholder workshops, lack of care facilities was mentioned as a problem for children under 6 and for after-school time and holiday periods of elementary school students. This is in line with official statistics on daycare facilities for Lower Austria (AK NÖ 2012). Good practice examples for local leisure activities exist and should be promoted. Music teachers, for example, offer lessons in community houses in some villages in the study area (Unbehaun et al 2014). Table 3 summarizes the suggested measures and differentiates between them along the 5 identified clusters. Some of the measures are suitable for all clusters, and others are especially useful for specific clusters.

Existing dial-and-ride transit and minibus systems in the region currently lack acceptance. However, several successful examples of commonly or cooperatively organized shuttle bus and taxi services are available in Austria, such as *Tälerbus* (Arbeitskreis öffentlicher Verkehr 2014), *Gseispur* (Nationalpark Gesäuse GmbH 2014), and *nextbike* (NÖ Energie- und Umweltagentur Betriebs-GmbH 2014); for more examples, see http://www.regionale-mobilitaet.at/index.php/beispiele/sliderpraxisbeispiele (B-NK GmbH 2104). Further research is needed to identify systems with (1) high usability for the target group under survey, (2) high potential for significant reduction of car dependency and consistently high accessibility and life quality, and (3) high ability to support autonomous multimodal travel of care persons and cared persons.

Conclusions

The goal of this study was first to analyze the interplay among care, employment, and mobility in a sex-disaggregated way, and thus to understand how working women and men with care responsibilities organize their daily lives. Second, we aimed to analyze gender differences in the activity patterns. Third, we aimed to derive insights into measures that improve people's mobility and reduce car use, thus improving the environmental quality of landscapes in attractive and sensitive mountain regions.

Addressing the first research question about activity patterns using cluster analysis, we identified 5 subgroups within the sample population: 2 clusters work more and care less, with significant differences in commuting distances; 2 clusters care more and work less, with one of them working only few hours and caring for very young children, and the other working and caring a lot; people in the fifth cluster care for elderly persons, have almost no pickup/drop-off trips, and almost all have full-time jobs.

Consistent with the literature, significant gender differences exist in the identified activity patterns, thus confirming the hypothesis in the second research question. Results show that responsibility for care is still mainly with women, even if women are increasingly seeking employment in paid jobs. Employment patterns seem to be more dynamic than the allocation of household tasks.

Based on the insights gained into the characteristics of the group under analysis, 3 major fields of actions were derived to address research question 3: measures to support the mobility of persons responsible for care, measures to increase the autonomy of cared persons' mobility, and measures to reduce the mobility needs of both are and cared persons. Some of the recommendations made address the needs of all 5 clusters, while others are specifically meant for selected clusters.

Altogether, respondents reported satisfaction with the way they managed their care tasks and employment, but they were dissatisfied with current mobility patterns, both as individuals and as a community. Respondents were aware of the problems. They saw the advantages in reducing car dependency and seemed to be ready to reduce car use and to increase their children's travel autonomy if alternatives were adapted to their needs. Reducing car dependency and increasing walking, cycling, and use of public transport were felt to be beneficial for time and financial budgets, and for preserving the sensitive mountain habitats in the area while ensuring accessibility.

The methodological limitations of the study were the following: (1) the strict screening process led to exclusion of 503 persons. For further studies it would be interesting to get more information, for example, on sociodemographic variables also for persons who only care but do not work or study, and to compare these with the group presented in this article. (2) Further work should also include spatial information such as distances to daycare and other facilities, in order to learn more about the interplay between demand and supply on a disaggregated level. We have started working on trip chaining, for example; with 2.7 trips per trip chain, respondents' trip chains are shorter than expected, and 60% of all trip chains in the sample have only 2 trips (trip to the destination and back home). We also plan to compare our data with a matched sample from the representative mobility survey conducted in Lower Austria to further validate our results.

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