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Article

Zero-Car Households: Urban, Single, and Low-Income?

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Abstract
This article unravels, by employing two binary logistic regressions, the socio-economic profiles of zero-car households in Flanders (Belgium) and sheds light on their residential environment. The employed dataset contains information regarding the socio-economic status and car ownership of all individuals with a home address in Flanders. Furthermore, the study explores the proportion and size of voluntarily car-free and car-less households due to constraints within the Flemish population. It does so by classifying zero-car households based on a spatial typology and the income decile these households belong to. Results indicate that zero-car households are overrepresented at the bottom of the income distribution and are overwhelmingly single. Children's presence contributes to the likeliness that a household owns a car. The spatial typology (urbanised, suburban, or rural) and the presence of public transport are minor but remain significant contributors. The main contribution of this article is that it highlights that despite the evidence that zero-car households are strongly present in urban areas, the share of zero-car households living in remote areas may not be underestimated. For the total population in Flanders, 5.47% of households may face problems due to their residential location and lack of a car, which comes on top of dealing with modest or low household budgets. Almost 37% of the zero-car population lives in an urbanised area and has a low income. This corresponds with 8.4% of the Flemish population. This group likely experiences a latent demand for car ownership. The households we can confidently identify as car-free, deliberately and voluntarily living without a car, are a minority group and account for approximately 5% of the Flemish population. The article concludes with the notion that involuntarily carlessness can be considered a proxy for vulnerability. However, urban planning centred around proximity, accompanied by housing policy that benefits low-income groups, can act as a buffer against transport vulnerability.

Keywords
car ownership; Flanders; urban planning; zero-car households

Issue
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1. Introduction and Literature Review

Many scholars amply demonstrated that navigating in a car-dependent society without access to a car can be challenging. Hence, every household comes to a point where they negotiate on purchasing a car. The outcome of that negotiation bears consequences: it matters whether households forego buying a car due to constraints, for instance financial, or they do so voluntarily, by choice. Hess (2022) found that voluntarily getting rid of a car can increase well-being, but, at least in the short run, enforced carless living can reduce it. Mitra and Saphores (2020) also registered an impact on well-being, as zero-car households are less mobile, which may lead to isolation. Moreover, Morris et al. (2020) linked carlessness to a substantial "activity penalty" mainly in but not restricted to rural areas. Without a car, leisure activities are more associated with friction and inconvenience, even for families who voluntarily live without a car (Baumgartner et al., 2022; Lagrell et al., 2018). Furthermore, a meta-analysis established that car ownership significantly increases individual employment probabilities (Bastiaanssen et al., 2020). Against this background, it is no surprise that a limited household budget, rather than choice, steers car ownership (Brown, 2017). However, these findings contrast sharply with a current circulating discourse that associates the relinquishment of the ownership of a private vehicle with feelings of

freedom. Media interview members of zero-car households from Flanders (Belgium) consider car-free living a goal to pursue and easy to reach, as these quotes illustrate: "In my view, the luxury and freedom of the car is overestimated" (De Roo, 2022); "Our children prefer the bike over the car" (Poppelmonde, 2021); "Without a car? In our view, it is peanuts. Just change your mindset" (Lanssens, 2018). A recent campaign in Flanders called "thirty lesser car days" recruited with arguments such as "embarking on an adventure" and "beneficial for budget and health." Participants were complimented as instigators of change (Buggenhout et al., 2022).

Hence, it is clear that zero-car households are not a homogeneous group. In order to stress their heterogeneity, Brown (2017) suggested a distinction between car-less households, due to constraints, vs. households that are car-free by choice. She argued that this distinction is more than semantic novelty. Indeed, the diversity among zero-car households has important policy implications for urban planning.

In a European context, higher education correlates with being voluntarily car-free (Kühne et al., 2018). Similarly, Baehler and Rérat (2020) note an overrepresentation of highly educated families in German and Swiss housing developments where residents consciously commit to living without a car. Car-free households are clear-cut examples of residential self-selection, as they can self-select themselves into dense urban neighbourhoods, well connected with public transport (Baehler & Rérat, 2020; Mitra & Saphores, 2020). Paijmans and Pojani (2021) concluded that voluntary carlessness is an educated middle-class phenomenon for people willing to challenge automobility as the societal norm.

A completely different picture emerges when we draw attention to the involuntarily car-less group. Mattioli (2014) demonstrated that zero-car households in peripheral and rural areas are often characterised by a marginal socio-demographic status. Car-less households more often have lower income and education levels (Karjalainen et al., 2021; Mitra & Saphores, 2020) and, in that sense, are a vulnerable group, especially when combined with residential locations in remote areas, as this strongly reduces accessibility levels.

Blumenberg et al. (2020) studied the issue of latent demand for car ownership in the US and found that this demand mainly occurs at the bottom end of the income distribution. In the same vein, in Europe, "not being able to afford a car" is a major reason for not having one (Dargay et al., 2008, p. 48).

Therefore, it is necessary to further unravel the socio-economic profiles of zero-car households and shed light on their residential environment. Doing so will inform us about the levels of accessibility zero-car households can enjoy. Also, following the call of Brown (2017), I aim to explore the proportion and size of the voluntarily and involuntarily zero-car households in the Flemish population, as currently, far more attention flows to the group that has consciously chosen to live without the private ownership of a car. Is that attention commensurate with their actual share?

These research goals translate into three research questions:

(1) What key socio-economic and spatial variables contribute to car ownership in Flanders?

(2) What is the share of car-less (by constraint) and car-free (by choice) households in Flanders?

(3) Do these households and the members of these households differ in socio-economic background?

Regarding the first research question, our knowledge is quite extensive already. Zero-car households are more likely to reside in dense urban neighbourhoods, well-connected with public transport access (Cao et al., 2007; Clark et al., 2016; Van Acker & Witlox, 2010). However, for the Helsinki Metropolitan Area, Karjalainen et al. (2021) found that this was mainly the case for affluent car-free households. Less affluent households reside in more car-dependent locations or accessible yet expensive areas, which might pressure household budgets. Kühne et al. (2018) revealed that employment density and public transport had a higher impact on the presence of car-free households in Germany than in California. For the Netherlands, Oakil et al. (2016) found a more substantial influence of the built environment on car ownership for young couples than for young families or singles. Concerning socio-demographic characteristics, research points in the same direction. Income, the number of household members and the presence of children emerge as the most important predictive variables (see, for instance, Baehler & Rérat, 2020; Clark et al., 2016; Kühne et al., 2018; Mitra & Saphores, 2020; Nolan, 2010). Having young children raises additional travel needs. A car is considered the best option, irrespective of where these families live (Oakil et al., 2016). Regarding individual characteristics, ageing correlates with a decline in car ownership. This is due to retirement and the accompanying changes in travel patterns, loss of income, or the deterioration of cognitive and psychomotor skills (Clark et al., 2016; Dargay et al., 2008; McNamara et al., 2013). Single pensioners and students are most likely to be car-less (Karjalainen et al., 2021). Dargay et al. (2008) and Oakil et al. (2018) found that car ownership is gendered: Women own a car less often than men.

Concerning the second and third research questions, only a handful of studies estimate the proportion of car-free and car-less households. Haefeli and Arnold (2015) found for Switzerland that the proportion of car-free young urban residents with high education and income doubled between 1994 and 2010. Brown (2017) found that within zero-car households 79% are involuntarily car-less in California. For Europe, we largely remain in the dark. Hence, Karjalainen et al. (2021) argued that zero-car households require increased attention,

especially regarding choice or constraint. This study is an attempt to increase our knowledge on the subject. I particularly focus on the size and proportion of zero-car households by choice on the one hand and by the constraints on the other hand, and their specific socio-economic characteristics.

2. Study Area and Methodology

The research area is the Flemish Region, part of Belgium. Belgium is a federal state, divided into three regions: the Flemish Region (Flanders), the Walloon Region (Wallonia), and the Brussels Capital Region (Figure 1). The Brussels Capital Region, which is the largest agglomeration in Belgium with over one million inhabitants, is geographically situated in the centre of Flanders, although it is not administratively part of it. For a study of car ownership in Brussels, I refer to Ermans and Henry (2022). The employed dataset for this study was provided by Statbel, the Belgian Office for Statistics. It contains information regarding the socio-economic status (gender, age, employment, education, household composition, and statistical ward of the residence) and car ownership of all individuals with a home address in Flanders (for the study area: individuals >18 years old n = 5,228,915 and households n = 2,769,599) for the year 2018.

To investigate the impact of built environment characteristics on car ownership, I complemented the data from Statbel with those collected in the Flemish *Spatial Report*, which describes and analyses the current state of affairs of the land use and the built environment in the Flemish Region. The report distinguishes three typologies of land use: urbanised, suburban, and rural (see Figure 2). The distinction resulted from an analysis by which three main variables were taken into account: population density, the density of job accessibility, and the share of land taken by development, which is the amount of land dedicated to buildings and infrastructures (Pisman et al., 2018). The distinction is made on the level of statistical wards. The urbanised part of the Flemish Region is characterized by a high use of space (≥32.5%, which is above the average in the Flemish Region), a population density of a minimum of 1,185 inhabitants per square kilometre or an employment rate of more than 1014 employees per square kilometre, and this within a cluster of at least 15,000 inhabitants. Urbanised areas mainly include city centres and employment sites in the urban fringe. The suburban part of Flanders is characterized by a high use of space (≥32.5%) but a low employment density. Suburban clusters are situated adjacent to the urbanised areas, typically consisting of allotments with residences and villas on substantial parcels or expanded villages that gradually merged with the urban fringe. The rural part of the Flemish Region includes one of the following features: (a) a use of space below 32.5%; (b) a use of space ≥32.5% and a high employment density but not situated adjacent to an urban cluster of 15,000 residents; and (c) a use of space that is above average, a low activity rate and not adjacent to an urban part. These areas consist mainly of scattered land use and centres of villages or minor cities that do not reach the threshold of 15,000 inhabitants (Pisman et al., 2018).

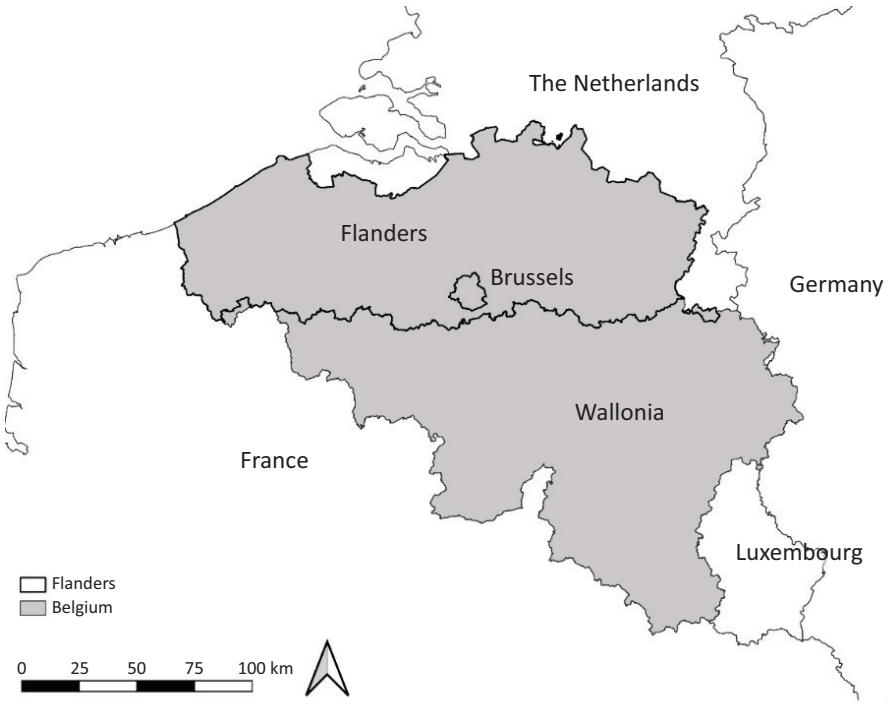

Figure 1. Flanders situated in Belgium.

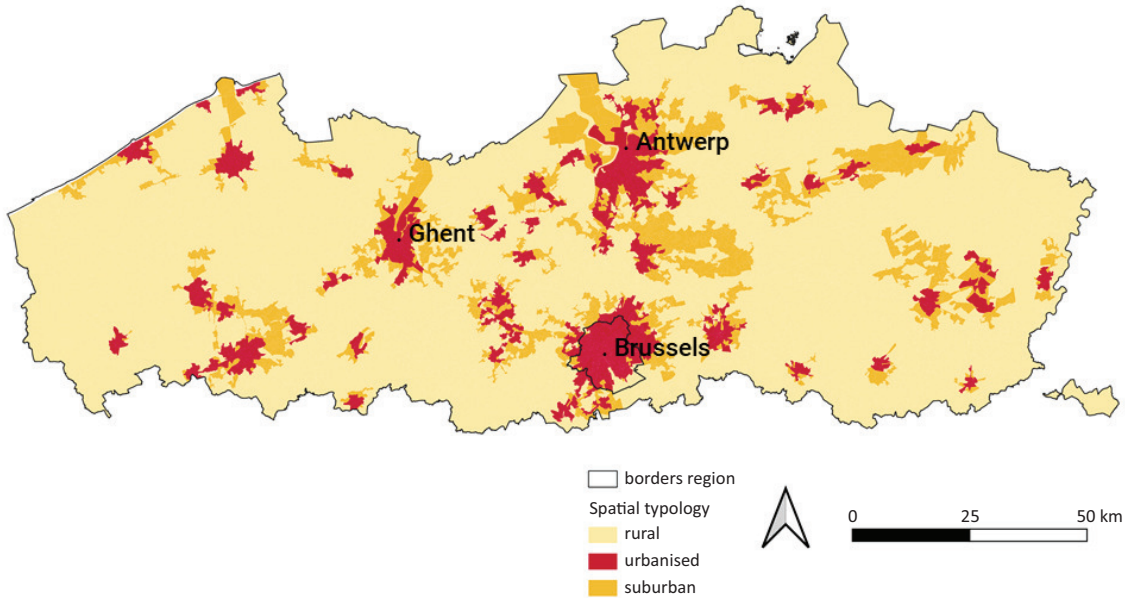

Figure 2. Spatial typology of Flanders. Source: Based on Pisman et al. (2018).

This spatial typology does not contain information on accessibility by public transport in the Flemish Region. I collected this from a study by Verachtert et al. (2016), which methodology was based on Spatial Network Analysis for Multi-Modal Urban Transport Systems (Curtis & Scheurer, 2010). Spatial Network Analysis for Multi-Modal Urban Transport Systems analyses the accessibility characteristics of public transport systems based on five indicators: closeness centrality, degree centrality, contour catchment, nodal betweenness centrality, and nodal connectivity. Verachtert et al. (2016) added a sixth variable—slow traffic infrastructure density—which refers to infrastructure for pedestrians and cyclists. In this article, I use these six indicators' aggregate variables, summarised into a node value. The value ranges from one to eight, whereas one implies minimal access by public transport, and eight refers to high access by public transport (train stations including international stops, ample opportunities to transfer to local train network and bus/tram, and a fine-grained network for pedestrians and cyclists; Figure 3).

I first describe the method to answer my first research question: what are the pivotal socio-economic and spatial variables predicting car ownership? As the decision to purchase a car is expected to be taken at the household level, I primarily use the household as a unit of analysis. However, also individual characteristics play a role in the decision-making process of a household. Therefore, the second part of the analysis takes these into account. My main interest is in the variables contributing to households having zero cars, not in which ones contribute to owning two or multiple cars. Dargay and Hanly (2007) concluded that households switch relatively easily between one and two cars but rarely between one and zero. Moreover, motivations to purchase a second car can deviate strongly from motivations to buy a first one (Clark, 2009; Witte et al., 2022). Therefore, I ran two binary logistic regressions, one with the household as the research unit, and one with the individual as the research unit. The presence of at least one car (yes/no) functions as a dependent variable. I do not distinguish between a car purchased by the household or a company car provided by an employer. The company car is attributed to the address of the household that can benefit from it. A company car is defined here as a car made available to an employee by his/her company that may also be used for private purposes. In Belgium, company cars are used by employers as a partly tax-exempt component of the remuneration package companies offer to their staff and are therefore often called "salary car" (May et al., 2019). Statbel identified the households that can benefit from a company car via the tax declaration ("benefit of all kinds"). However, approximately 25% of the company cars (n = 150,000), which refers to 3% of all cars in Belgium, could not be assigned to a household. This is because the benefit of all kinds was not always specified (see also Ermans & Henry, 2022). This is important when interpreting results, as this means that the share of zero-car households is slightly lower than the results will suggest.

For the analysis of the level of the household, I included the following independent variables: household composition (categorical variable), income decile (ordinal variable), spatial typology (categorical variable), and node value (ordinal variable). I tested for potential multicollinearity between the variables. Multicollinearity occurs when two or more predictors in the model are correlated and provide redundant information about the response. Multicollinearity was measured by variance inflation factors (VIF) and tolerance. If the VIF value exceeds 4.0, or by tolerance is less than 0.2, then there is a problem with multicollinearity (Midi et al., 2010).

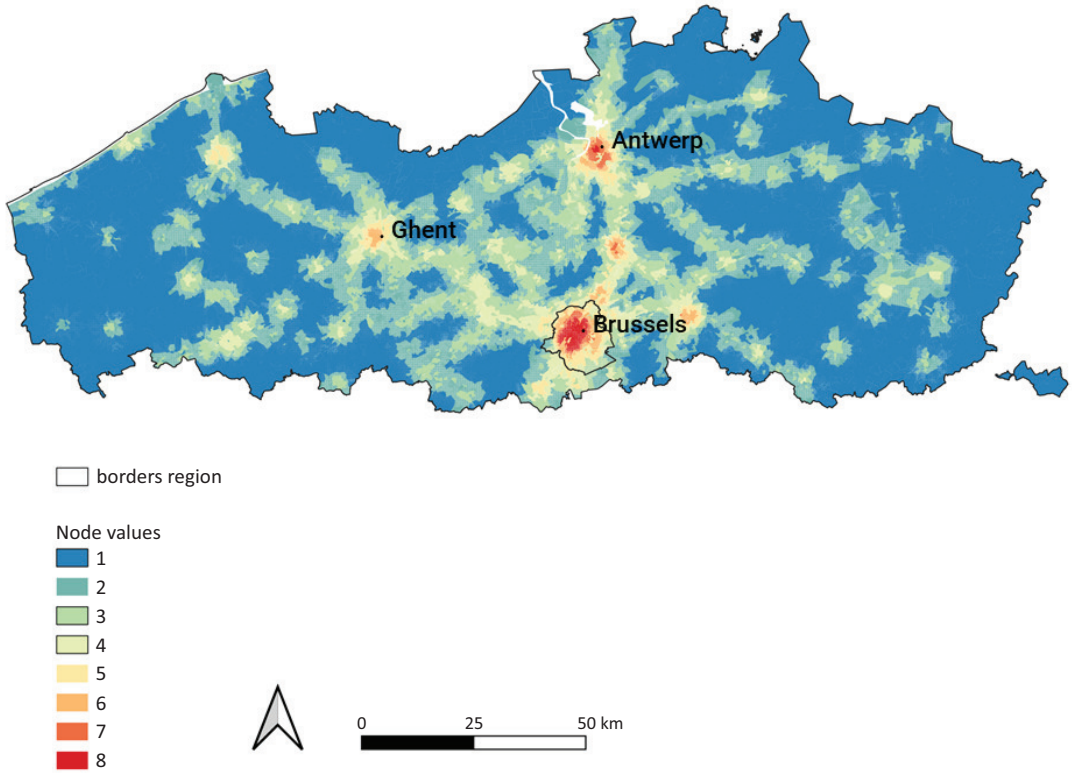

Figure 3. Node value for the Flemish Region. Source: Based on Verachtert et al. (2016).

VIF values ranged from 1.030 to 1.100, and tolerance from 0.909 to 0.971, safely below the threshold.

Although the household is the level on which the decision to purchase a car is taken, individual socio-economic characteristics do play a role, as the introductory literature review indicated. Therefore, I also ran an analysis on individual characteristics, and additionally assessed for the impact of age (categorical variable), education (categorical variable), and gender (categorical variable). Concerning multicollinearity tests, VIF values ranged from 1.070 to 1.217 and tolerance from 0.822 to 0.890.

To answer the second and third research questions—what is the share of voluntarily and involuntarily zero-car households in the study area and how do they differ socio-economically?—I build on the theoretical and empirical contributions of Brown (2017) and Karjalainen et al. (2021) and combine these with the results of the regression. The central assumption is that zero-car households in rural and suburban areas in the lowest income deciles are car-less by constraint. High-income households residing in an urbanised area are expected to be voluntarily car-free. I elaborate more on assumptions and methods in Section 4. All analyses were conducted using SPSS 28.

3. Results: Key Spatial and Socio-Economic Variables

3.1. Descriptive Analysis

Household motorisation rates in Belgium are slightly below the European average (506 vs. 560 per 1,000 inhabitants) (ACEA, 2022). 22.8% of Flemish households do not own a car. However, the share of zero-car households is distributed unequally. Figure 4 visualises a geographical imbalance. The figure highlights the locations of the most prominent Flemish cities: Ghent and Antwerp. For Brussels, not included in the study, the percentage of zero-car households amounts to 51.9%.

Figure 5 and Figure 6 illustrate the unequal distribution of car ownership along income lines, organised based on income deciles (whereas income decile one refers to the 10% of households with the lowest income in the population, and income decile 10 to the 10% with the highest income). The figures distinguish between one adult and two adults (or more) households. We observe that the lower the income, the less likely that a household will possess a car. At the upper half of the income distribution, zero-car households are a rare phenomenon. This trend applies to both one-adult and two-adult households. Higher incomes can benefit more often from a company car. For decile 10, more than 35% of households have a company car. For the deciles below six, this percentage drops far below five. If we compare both graphs, we note that the percentage of zero-car single households is higher in all income groups compared to the two adult households. This is a particular observation, as this indicates that, regardless of income, households with more than one adult will quickly proceed to purchase a car than a one-adult household with a similar income level.

Figure 7 below compares different household compositions in relation to car ownership. More than half

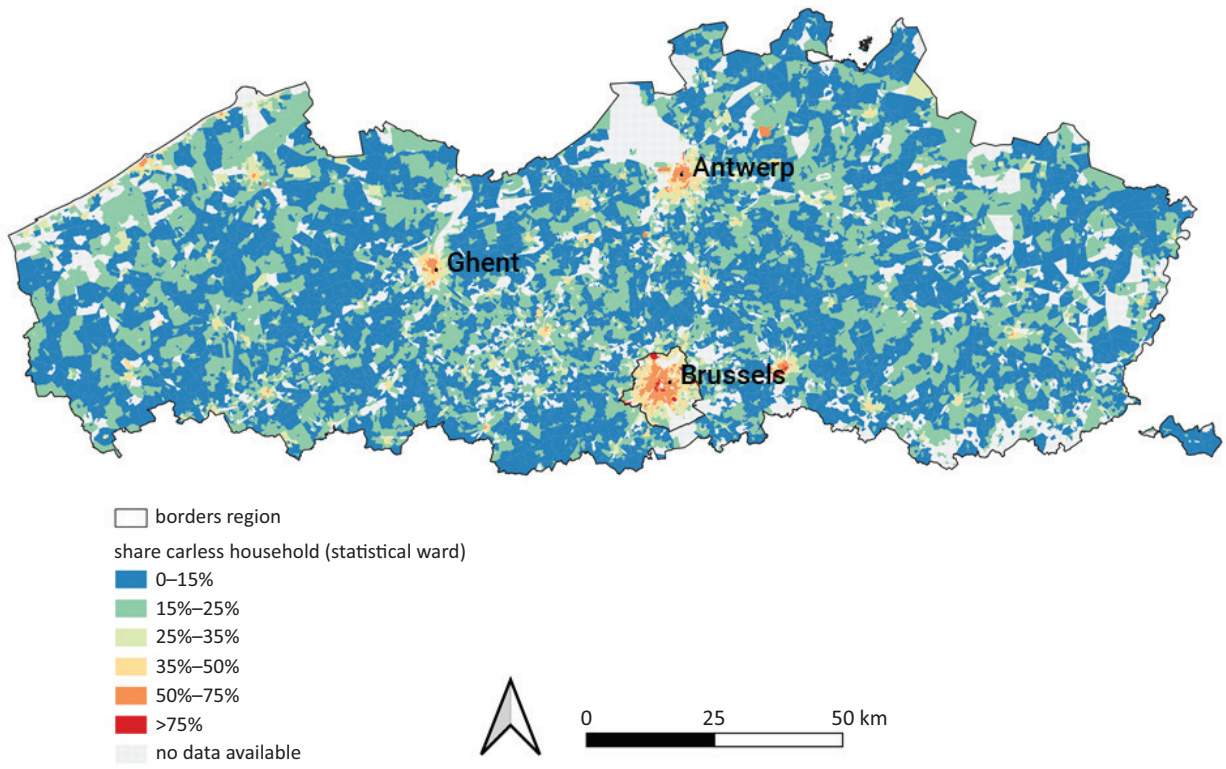

Figure 4. Geographical distribution of zero-car households in Flanders and Brussels.

of the singles are zero-car households—which was to be expected considering the previous graphs—and families with at least two adults are underrepresented in the zero-car group. The figure also makes clear that the presence of children affects car ownership levels.

3.2. Results of Binary Logistic Regression at the Level of the Household

The regression reports on the odds of a household having no car divided by the odds of a household having at

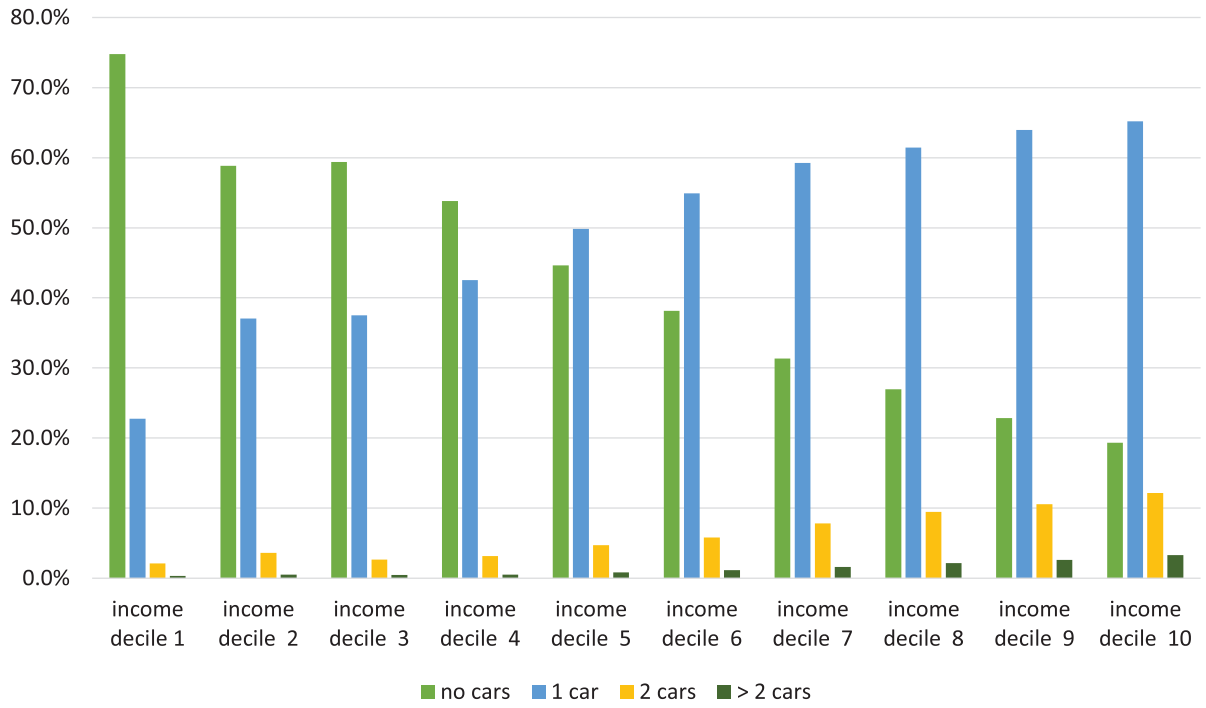

Figure 5. Distribution of car ownership vs. income decile, for households with one adult.

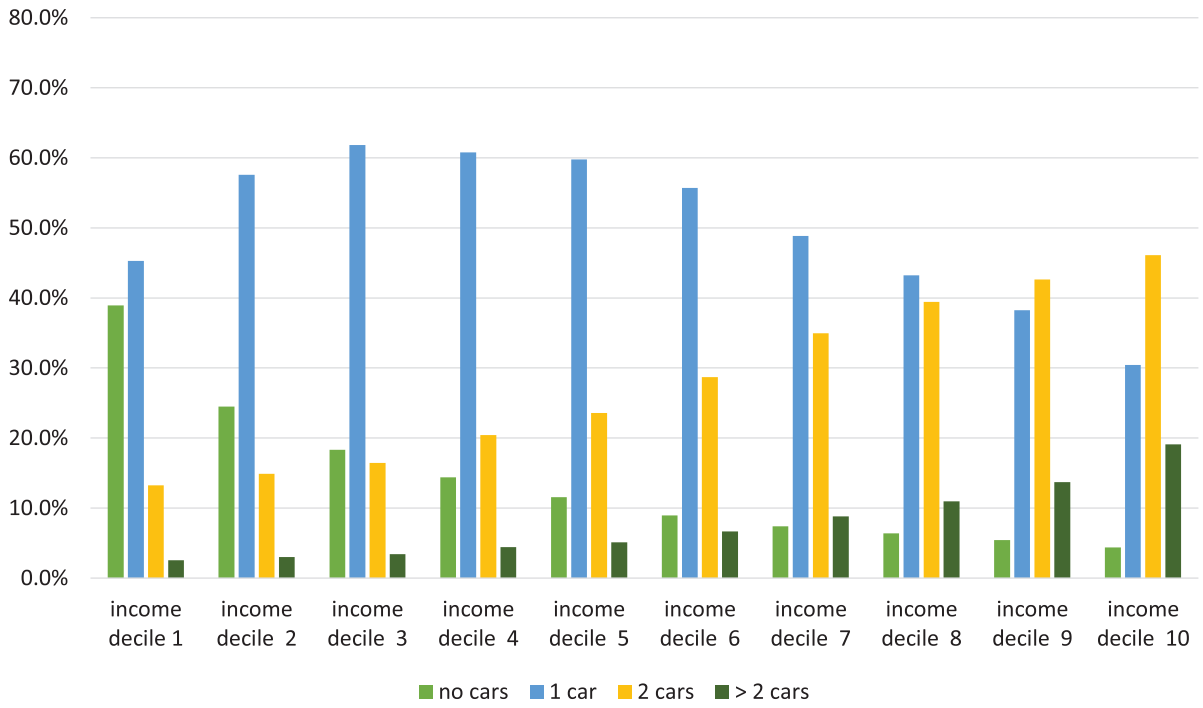

Figure 6. Distribution of car ownership vs. income decile, for households with at least two adults.

least one car. A zero-car single household without children residing in a rural area is the reference category for the regression. Exp(B) are the odds ratios for the predictors (the independent variables) and signals the predicted change in odds for a unit increase in the predictor. The "Exp" refers to the exponential value of B, the estimated coefficient. As Exp(B) is easier to interpret, I only added Exp(B) and the respective Confidence Intervals (CI) in the Table. When Exp(B) is less than 1, increasing values of the variable correspond to decreasing odds of the event's occurrence. The analysis shows that all variables are significant (<.01). The model (Table 1) confirms that, when controlled for income and household composition, built environment characteristics like spatial typology and node value influence car ownership. A household's likelihood of owning a car decreases as node value increases. Also, the odds of having no car in an urbanised area is 1.17 times (1/0.855) the odds of having no car in a rural area. It is more likely that a household does not own a car in a rural area than in a suburban area, although the Exp(B) is close to 1. Thus, a household residing in a rural or suburban area with a low node value is

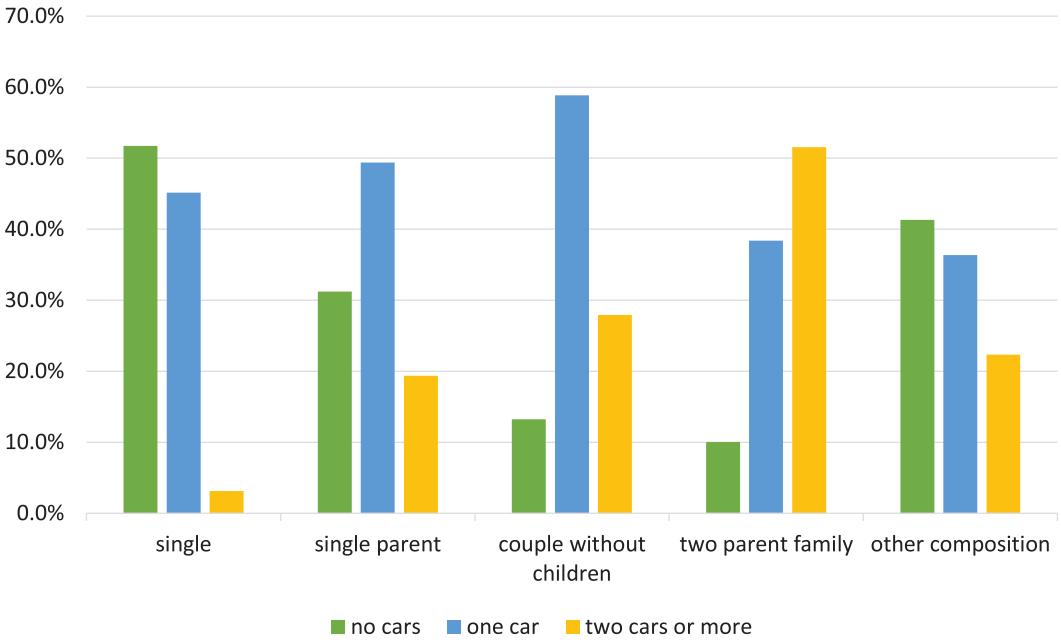

Figure 7. Distribution of household car ownership (%) per household composition.

Table 1. Results of binary logistic regression for households in the Flemish Region.

	Sig.	Exp(B)	CI. lower	CI. upper
Spatial typology (ref. rural)				
Suburban	<.01	1.040	1.029	1.050
Urbanised	<.01	0.855	0.847	0.864
Node	<.01	0.822	0.820	0.824
Household type (ref. single)				
Single parent	<.01	3.436	3.397	3.475
Partners no children	<.01	5.395	5.349	5.442
Partners children	<.01	9.053	8.966	9.142
Other	<.01	1.622	1.589	1.656
Income	<.01	1.322	1.321	1.324
Constant	–0.570			

Notes: Nagelkerke Pseudo R square: 0.349; McFadden: 0.243. Dependent variable: at least one car in the household (yes/no); reference category: single, no children, rural area; $p < .01$.

much more likely to own a car than a similar profile in an urbanised area.

Household composition emerges as a powerful predictor. The presence of children (<18) is related to the decision to purchase a car. The odds that single parents own a car is 3.436 times the odds for singles without children. Households with more than one adult are more likely to own a car. However, this does not imply that both adults have equal access to a car. For one-car households, when one partner uses the car, the other partner is without a car. In that sense, singles' car access is more guaranteed. This is a blind spot I do not address in this article.

Furthermore, the regression indicates that the odds of having a car increase per decile increase. This might feed the assumption that high-income households not only have a car because they consider needing one but also for the simple reason that they have more than sufficient purchasing power. Moreover, higher incomes are much more likely to receive a company car.

The regression indicates that both built environment characteristics and socio-demographic features influence car ownership. However, the influence of household composition surpasses that of node value and spatial typology.

Running the regression with only spatial typology and node value produces lower Pseudo R Squares compared to household composition (Nagelkerke: 0.204 vs. 0.229; McFadden: 0.134 vs. 0.153). Running the regression with income as the single independent variable, Pseudo R Squares notes 0.164 (Nagelkerke) and 0.106 (McFadden).

3.3. Results of Binary Logistic Regression at the Level of the Individual

In this part, I again ran a binary logistic regression, but now with individuals as the unit of inquiry. The regression thus reports on the influence of individual socio-demographic variables that might impact car purchases (Table 2). The reference category is a single male, born between 1990 and 1999 and a low education (no education, primary education, or lower secondary education) living in a rural area. All independent variables are significant ($p < .01$). Spatial typology, node value, income, and household composition produce similar odds ratios as in the regression conducted on the household level. Compared to the reference category, the age group most likely to own a car is born between 1940 and 1959. The odds ratio declines firmly for people born before 1940, with the odds of owning a car vs. not owning a car of 1.430 (1/0.699). The odds for groups born between 1970 and 1989 are close to 1. The likelihood of people possessing a car is highest for those aged 60 to 79. The likelihood decreases slightly in the groups born between 1970 and 1989. It is more likely that a person born between 1990 and 1999 will own a car than someone born between 1980 and 1989.

Concerning education level, the regression finds that individuals with a degree in secondary school or a bachelor's degree are more likely to own a car compared to the lowest educated group. The odds ratio for the highest educated groups is higher than for the reference group, indicating that highly educated people are more likely to own a car than low-educated people. However, the odds ratios for the highly educated group are smaller than those with a bachelor's or a secondary school degree. Finally, men are more likely to possess a car than women, although the odds ratio approaches 1.

4. Results: Zero-Car Households—Voluntarily or by Constraint?

The second aim of this study is to distinguish between voluntary and involuntarily zero-car households. In doing so, I build on the work of Brown (2017) and Karjalainen et al. (2021) and the regression results.

Table 2. Results of binary logistic regression for individuals in the Flemish Region.

	p-value	Exp(B)	CI. lower	CI. upper
Spatial typology (ref. rural)				
Suburban	<.01	1.038	1.029	1.047
Urbanised	<.01	0.858	0.850	0.866
Node	<.01	0.833	0.831	0.835
Income	<.01	1.260	1.259	1.262
Household type (ref. single)				
Single parent	<.01	3.748	3.706	3.790
Partners, no children	<.01	5.206	5.167	5.245
Partners, children	<.01	10.119	10.029	10.211
Other	<.01	2.095	2.066	2.125
Year of birth (ref. 1990–1999)				
1980–1989	<.01	0.877	0.866	0.889
1970–1979	<.01	1.030	1.017	1.044
1960–1969	<.01	1.373	1.356	1.391
1950–1959	<.01	1.688	1.666	1.710
1940–1949	<.01	1.691	1.668	1.714
1917–1939	<.01	0.699	0.690	0.708
Education (ref. no degree, primary school, or lower secondary school)				
Secondary school	<.01	1.296	1.287	1.305
Bachelor	<.01	1.510	1.494	1.527
Master	<.01	1.195	1.180	1.210
Gender (ref. male)				
Female	<.01	0.891	0.885	0.896
Constant	–0.530			

Notes: Nagelkerke Pseudo R square: 0.309; McFadden: 0.230. Dependent variable: at least one car in the household (yes/no); reference category: single, no children, rural area; p <.01.

The regression illustrated that the presence of children and having more than one adult in the household increases the likelihood of having a car in the household. Also, income emerged as a significant predictor: the regression demonstrated that a higher income increases the likelihood of car ownership. Age matters as well: From the age of 80, people are less likely to own a car. Built environment characteristics are significant but are by far the largest predictor of car ownership. However, their importance may not be underestimated, especially concerning zero-car households. The presence of an urban tissue with amenities in or in the vicinity of the neighbourhood, a higher density regarding work locations, and public transport provision guarantees minimum levels of accessibility for people without cars. This level of accessibility is less present in rural and suburban areas.

Therefore, we can safely assume that zero-car households in rural and suburban areas, especially those of lower income and with children in the household or over 80 years old, are car-less by constraint. On the other side of the spectrum, we may expect high-income and highly educated partners with children living in an urbanised area to be voluntarily car-free. However, there is a lot of diversity and variety between both ends of this spectrum. Iacobucci (2022) identified a grey area between choosing to save money and affordability issues and balancing supportive conditions for non-car travel. The purchase of a car remains open for negotiation in households and is strongly related to the specific context a household finds itself. Indeed, we must situate car-less, the latent demand for cars, and car-free on a continuum (Figure 8).

Table 3 organizes the zero-car households according to their residential area (urbanised, suburban, or rural) and income. The low-income group refers to households with income deciles one to four; the middle income refers to income deciles five to seven; the high income to eight to ten.

15.36% of the zero-car population lives in a rural area, and 8.69% in a suburban area. Of these car-less groups, respectively, 17% and 19% have children in the household. We may assume that these low-income households with children are the core group being car-less by constraint. Both suburban and rural households combine several characteristics that highlight their potential vulnerability. Their characteristics echo what Mattioli (2014) labelled double vulnerability: combining low accessibility with vulnerable socio-demographic

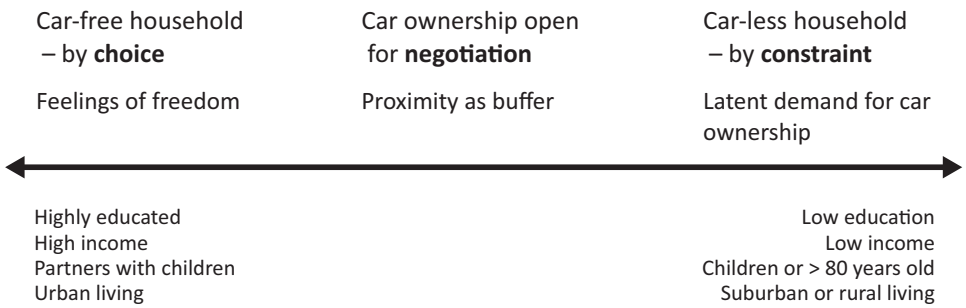

Figure 8. Zero-car households and their archetypical characteristics situated on a continuum from choice to constraint.

characteristics. Only 6.3% (rural) and 7.5% (suburban) obtained a bachelor's or master's degree. Approximately one-third of the members of these households are over 80 years old. To a certain extent, for them, zero-car ownership is an imposed choice which also makes them carless by constraint and dependent on a network of family, friends, and neighbours. For the total population in Flanders, 5.47% of households may face problems due to their residential location and lack of car.

When moving to the medium-income groups in rural and suburban areas, we notice that the size of these groups is half of that of the low-income groups (7.02% for rural areas, and 4.18% for suburban areas). The presence of children in these households equals that of the lowest income groups. The share of people over 80 years old is smaller and approaches one-fifth of the people belonging to that group.

Finally, concerning the highest income groups in rural (3.67%) and suburban (2.18%) areas: their presence is at odds with what would be expected. Why not purchase a car in an area that is, when interpreted through the lens of accessibility, quite car-dependent? One explanation

Table 3. Distribution of Flemish zero-car households along spatial typology and income.

Rural	Low-income (15.36% or *n* = 96,826)	Children in household: 17.0% Individuals age > 68: 44.3% (>80: 31.5%) Bachelor +: 6.3%
	Medium-income (7.02% or *n* = 44,257)	Children in household: 19.5% Individuals age > 68: 33.7% (>80: 20.7%) Bachelor +: 14.4%
	High-income (3.67% or *n* = 23,114)	Children in household: 23.5% Individuals age > 68: 20.5% (>80: 14.4%) Bachelor +: 36.1%
Suburban	Low-income (8.69% or *n* = 54,800)	Children in household: 19.0% Individuals age > 68: 40.0% (>80: 28.4%) Bachelor +: 7.5%
	Medium-income (4.18% or *n* = 26,379)	Children in household: 17.2% Individuals age > 68: 38.1% (>80: 24.3%) Bachelor +: 14.3%
	High-income (2.18% or *n* = 13,750)	Children in household: 23.1% Individuals age > 68: 23.5% (>80: 15.3%) Bachelor +: 38.2%
Urbanised	Low-income (36.92% or *n* = 232,756)	Children in household: 21.3% Individuals age > 68: 25.8% (>80: 15.7%) Bachelor +: 9.2%
	Medium-income (14.77% or *n* = 93,120)	Children in household: 13.5% Individuals age > 68: 35.6% (>80: 22.8%) Bachelor +: 15.7%
	High-income (7.21% or *n* = 45,458)	Children in household: 14.8% Individuals age > 68: 23.2% (>80: 14.7%) Bachelor +: 43.9%

Note: All on the level of the household, except for the variables age and education; only people 18+ included.

could be that they might not be a zero-car household due to the missed company cars (see Section 2 on methodology), mainly because here we find more than one-fifth of the households with children and a limited number of older people.

The zero-car households in urbanised areas are the largest group and the most heterogeneous regarding socio-economic characteristics. On the one hand, there is a group with a low income (36.92%) and low education, and in 21.3% of these households, children are present. They account for 8.4% of the total Flemish population. The low-income households in urbanised areas are, compared to all others, the youngest group with the smallest share of people over 80. For them, it is conceivable that there is a latent demand for car ownership, and they consider purchasing a car in case of an increasing household budget. Despite their vulnerable characteristics, they can benefit from high accessibility. In that sense, they are less vulnerable in terms of mobility options than the zero-car rural households.

What is remarkable for the households of urbanised areas is that we can identify a transition from vulnerable socio-demographic characteristics to the exact opposite. For the highest incomes, more than 43.9% have a bachelor's or master's degree. Interestingly, only 14.8% of these car-free households have children, which is the second-lowest percentage. When this group starts having children, they might purchase a car after all. When we sum up medium and high-income households in urbanised areas, we arrive at 5% of the total Flemish households. The number is likely even smaller, as we can also expect some not-assigned company cars in this group.

5. Conclusion and Discussion

In this article, I first focused on the diversity regarding socio-economic and spatial variables correlating with car ownership. Secondly, I aimed to distinguish households between car-free by choice and car-less by constraints and gauge their respective shares within the population. The outcomes for the first question strongly concur with previous findings: Zero-car households are strongly overrepresented at the bottom of the income distribution. The most prevalent household composition is singles. Children contribute strongly to the likeliness that a household owns a car, and single parents are likelier to own a car than singles without children. However, the overall financial burden for single parents is often heavier than for singles without children, and a car seizes firmly on the household budget. It is more likely that households with two adults possess a car, also in the lower income groups. Probably, these households are more assured of a permanent, stable income which is known to increase the likelihood of car ownership (Nolan, 2010). However, for one-car households, when one partner uses the car, s/he leaves the other without one. In that sense, singles' car access is more guaranteed. This is a blind spot I did not address in this article.

The likelihood that people with a master's degree have a car in a household is smaller than those with a secondary or bachelor's degree. This could be because they are more likely to be white-collar workers with an office at a central location close to a public transport hub and ample opportunities for teleworking, which makes a car for commuting redundant.

Regarding the role of the built environment for car ownership, spatial typology and accessibility by public transport are minor but remain nevertheless significant contributors.

Concerning the second and third research questions, my study yielded a similar result as Karjalainen et al. (2021) for Helsinki and Mattioli (2014) for the UK: Households without cars also reside in car-dependent rural and suburban areas. For the studied region, this is even the largest group. The main contribution of this article is that it highlights, based on a dataset that contains the whole population, that despite the evidence that zero-car households are strongly present in urban areas, the share of zero-car households living in remote areas may not be underestimated. In these areas, accessibility by public transport is limited, which comes on top of dealing with modest or low household budgets. Also, zero-car urban households are overwhelming low-income. The households we can confidently identify as car-free, deliberately and voluntarily living without a car, are a minority group, however very present and visible in media coverage. In Flanders, car-free households are an educated middle-class phenomenon, which corroborates with the findings of Paijmans and Pojani (2021). The group that likely experiences car-freedom and thus voluntarily has refrained from car ownership remains an exception, especially when children are involved. Members of zero-car households are overwhelmingly low-income, low-skilled, and often also of higher age.

As a reduction in car ownership is likely to help reduce emissions (Aguilera & Cacciari, 2020), it is vital to avoid future car purchases. Public transport is of utmost importance to make car-free living feasible and to maintain and improve accessibility levels of other, non-voluntary zero-car households. However, when considering car purchase restriction policies, it is essential to keep the findings of this study in mind. For instance, with a general increase in car ownership cost, lower income groups will likely have to drop out first for car ownership. This is questionable in terms of fairness.

Moreover, previous research highlighted that higher-income groups travel more kilometres with their cars (see, for instance, Van Eenoo et al., 2022, for the case study region). Consequently, the effect of reduced car ownership will be limited in carbon emissions when only the low incomes drop out. Therefore, governments could experiment with price settings that proportionate household income or type of vehicle. In that sense, the main goal is to reduce car ownership at the top, not, or not in priority, at the bottom. For households with children,

public transport or the bicycle currently needs to compete sufficiently with the comfort, convenience, and feelings of safety attached to the car. A planning policy centred around proximity and accessibility—to reduce travel time and distance to schools, sports, and hobbies to prioritise walking and cycling—is essential here. Moreover, traffic safety measures are pivotal, especially for young cyclists and pedestrians.

The current tendency to scale up amenities such as schools and hospitals in the studied region (Matthyssen et al., 2019; Storme et al., 2015) could impact car ownership. Urban planning can act as a buffer against transport vulnerability. Maintaining and strengthening proximity is crucial, as this guarantees minimum levels of accessibility and avoids the risk of car-related economic stress or transport poverty in the case of a move towards suburban or rural areas. This requires a planning and housing policy that centres around affordable housing, the proximity of amenities, and accessibility by public transport (Mattioli, 2017). This is all the more important as the Flemish Region is ageing rapidly (Volckaert et al., 2021) and the elderly tend to refrain from car ownership.

My findings align with the argument of Brown (2017) and Karjalainen et al. (2021). Although the media strongly focuses on voluntarily car-free households, involuntarily carlessness should be considered as a proxy for vulnerability. The needs of zero-car households should be recognised as a particular group in sustainable urban planning (Karjalainen et al., 2021; Nieuwenhuijsen & Khreis, 2016). The biased view leaves zero-car households due to financial or other constraints largely out of sight, risking too limited attention from policymakers.

This study remains exploratory, and it is essential to highlight some limitations. Although the dataset consists of all households and individuals in Flanders, it comes with some restrictions. An important one is that it lacks personal motivations and reasons for zero-car ownership. Furthermore, there is the issue that not all company cars were assigned to a household. Also, co-parenting was not taken into account: Children are registered with one parent, so it is conceivable that, in reality, there are more single parents than the dataset reveals. The dataset does not allow us to identify which households are members of a car club or are part of car-sharing initiatives or informal car-sharing between families. It is imaginable that some of the zero-car households, especially those living in an urbanised area where car sharing is well established, are acquainted with car sharing and hence often travel by car, for instance, during leisure time. Moreover, a longitudinal study could inform us about evolutions in household motorisation rates in the identified groups and areas, for instance, when children are born or when people move house. Finally, the dataset does not contain information on, for instance, the physical ability of people to drive a car, nor does it on driving anxiety. Both influence car ownership (Witte et al., 2022) but are out of the scope of this article. Nevertheless, the adopted approach allows differentiation among zero-car households, exploring proportions and describing characteristic features for each group.

Finally, I formulate some avenues for further research. Thus far, the topic of unmet or latent demand for car ownership and the relationship between residential location and car ownership is underexplored and deserves more research attention, for instance, how households negotiate between living in an, on average, more expensive central urban area and as a result are no longer able to afford a car and living in a more remote area with a car. The same goes for "car-deficit" households (Blumenberg et al., 2020), which refers to households where there are more adults than cars. Finally, qualitative research can shed light on the practices of the identified zero-car households to unravel how they navigate in a car-dependent society.

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Conflict of Interests

The author declares no conflict of interests.

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