Accounting for care in everyday mobility: an exploration of care-related trips and their sociospatial correlates

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Mobility of care, active mobility, gender, trip purposes, Barcelona Metropolitan Region.

Abstract

Since care is an essential part of our individual and collective survival, there is the challenge to explore how care operates through daily mobility patterns in urban settings. This paper takes the recently coined concept of "mobility of care" to assess care-related trips from a quantitative perspective in the Barcelona Metropolitan Region (BMR), by using an official household travel survey. We also examine the individual, household and territorial factors associated with trips related to care, and we explore their relationship with transportation modes. Our results showed how care-related trips are a crucial portion of the overall everyday mobility in a Mediterranean metropolis such as Barcelona. We also observed that mobility of care is more relevant among women and that it increases with both age and the presence of dependents in the household, especially with minors. Additionally, the mobility of care in Barcelona is mostly conducted in active modes, especially in large and dense urban areas within the region. Finally, our findings suggests that while the concept of mobility of care helps to conceptualizing a key part of our daily reality and helps identifying possible social inequalities, it is still necessary to account and understand specific care-related purposes. The findings from this study are expected to contribute to further develop research on mobility of care, as well as to inform urban policymakers in their efforts to push for more sustainable and equal cities.

1. Introduction

In recent years, sociodemographic changes such as population ageing, reorganization of gender roles and new familiar models have interacted with the weakening of the welfare state to create a "crisis of care". In this context, feminist ethics assert the importance to understand care as a collective and public concern that arises from inherent interdependency of human existence (Power & Williams, 2019). Care activities are considered as indispensable to "maintain, continue, and repair our world so we can live in it as well as possible" (Fisher & Tronto, 1990), which have been further evidenced after COVID-19 crisis (Springer, 2020). Under these circumstances, care is today a key priority for policy agenda, thus representing a relevant issue that needs to be recognized, studied and considered in policymaking.

In the field of geography, there is a growing number of scholars that are placing care at the heart of their research, examining how care activities are influenced with everyday spaces and practices (Wiesel et al., 2020). Mobility studies in particular have been key to this discussion as long as care is an everyday life activity that has a clear translation to our everyday mobility patterns. More specifically, mobility under the lens of gender studies had been pioneer to address this issue by reporting those trips related to daily care activities (Coutras, 1993). In the recent years, the innovative term of "mobility of care", coined by Sanchez de Madariaga (2013), has given a new impetus to visualize a domain of trips that are usually associated with women, mainly related to home and caring tasks (Sánchez de Madariaga, 2013). This umbrella term has been recently

recognised by policymaking institutions as an strategic concept to guide public transport policies in terms of gender equality (European Commission, 2013), and is also gaining academic relevance in the fields of urban planning, mobility and transport studies.

Studies to this date focusing on mobility of care have mostly done so from a qualitative and experiential perspective. While such approach not only is valuable but can should also be regarded as critical, there is still a need to quantify and provide a comprehensive depiction of mobility of care and its determinants. In this sense, considering few recent exceptions, there is a general lack of quantitative studies on mobility of care due, in part, to methodological difficulties in assessing care-related trips (Ravensbergen et al., 2022; Sánchez de Madariaga & Zucchini, 2020). As long as proximity dynamics, where active mobility is predominant, are those who better support care-related trips, there is also a need to explore their associations with active modes. In order to help bridge these gaps, we aim to quantify mobility of care and examine its sociodemographic and territorial correlates by means of an official household travel survey in the Barcelona Metropolitan Region (Spain).

2. Theoretical framework

2.1. Defining and accounting for care

The need to revaluate caring tasks is gaining momentum both in the academic field and in public policy around the world (United Nations, 2021). The discussion about caring tasks, however, originated among sociologists in the 1980's, triggered by pioneering contributions by Italian scholars such as Balbo (1989), Bimbi (1985) and Saraceno (1980). They introduced the concept of "*il lavoro di cura*" to refer to time spent mainly by women in care activities that had traditionally remained invisible in western societies.

To this date, however, there is no consensus about a clear definition of what care involves, and so scholars have outlined different aspects of what care means depending on their theoretical backgrounds, sociocultural contexts and methodological approaches (Carrasco et al., 2011). As mentioned, care was initially referred to the unpaid work carried out by women to produce a fundamental market good: the reproduction of life and well-being (Bimbi, 1995). Later on, Anglo-Saxon scholars defined care as "*physical and emotional labour*" for the well-being of others, which is not comparable to that operating under the rules of market production, as it is built upon emotional ties (Graham, 1983). Aside from the relational implications of care, in a context of deployment of welfare states and policies, from North-European countries the notion of "social care" appeared to refer to all activities that sustained people's physical and emotional needs that were covered from the state, the market, the family and civil society (Daly & Lewis, 2000). Finally, more recently, care-related research without any specific territorial context but mostly from mental health studies have introduced the idea of "self-care" as in important source of wellbeing which is also socially necessary(Matarese et al., 2018). . These theoretical approximations opened an opportunity to account for care activities in analyses of social issues and everyday life. Some authors initially denounced the omission and undervaluation of the care dimension and domestic work in fields such as statistics (Benería, 1992), and to this date many other authors have attempted to measure caring tasks in different fields such as sociology (Duffy et al., 2013), labour (Chant & Pedwell, 2008), economy (Folbre, 2006; Serrano & Carrasco, 2006), public policies (Budlender, 2008) and public health (Kim, 2018).

In the field of human geography, recent studies have also been concerned about this issue and have also contributed to account for care too (Middleton & Samanani, 2021).

More specifically, transport and mobility studies have recently started to explore the role of care strategies and the reproductive sphere in daily mobility and travel behaviour (Croucher et al., 2020; Gilow, 2020; Scheiner & Holz-Rau, 2017). In this sense, mobility is studied not as an object of analysis but as an approach through which we can reveal and further understand the spatial structure of care tasks (Jirón & Imilán, 2018).

2.2. Mobility of care: what is it and how is it studied?

Within mobility and transport research, we also found innovative notions to precisely conceive and analyze the journeys connected to care and domestic sphere. As a pioneer attempt, the work of Jacqueline Coutras (1997), who invented the term "mobilité domestique" ("domestic mobility") to call attention to the journeys undertaken by women to complete reproductive labour, deserves special recognition. However, despite its novelty, this concept has not gained a great attention in academia and policymaking.

In the recent years, the term “mobility of care” is gaining acceptance as a new concept to study care trips. Coined by Sanchez de Madariaga (2013), mobility of care refers to “*all trips resulting from home-and-caring responsibilities (escorting others, everyday shopping, household maintenance, organization and administrative errands and visits to take care of sick or older relatives)*”. If previous research had examined the role of care by focusing on specific trip purposes (e.g. house-related errand or accompanying other household members), the new “mobility of care” concept aims to be an umbrella term that brings several trip purposes together under one single framework.

In this context, a growing number of case studies are using the term mobility of care to discuss gender differences in mobility patterns in different geographic contexts (Blumenberg, 2016; Gimenez-Nadal & Molina, 2016; Maciejewska & Miralles-Guasch, 2019). Among such studies, a smaller number of scholars are placing “mobility of care” in the centre of their research, and particularly focusing in specific demographic groups such as women (Gilow, 2020; Grant-Smith et al., 2017; Jirón & Gómez, 2018; Sersli et al., 2020) and seniors (Croucher et al., 2020). Such studies mostly consist of qualitative approaches that provide an in-depth account of their mobility experiences, daily strategies and efforts required by the management of family and household, and the trips that resulted from their responsibility as caregivers. However, to this date, there is a general lack of quantitative evidence of what mobility of care represents, with only some recent exceptions (Ravensbergen et al., 2022; Sánchez de Madariaga & Zucchini, 2020).

The lower number of quantitative examinations of mobility of care is in part due to inherent biases and omissions in most travel survey designs. In other words, the way in which mobility surveys have traditionally defined, collected and analysed trips has often relegated care-related purposes to a residual role (Miralles-Guasch, 1998). These trips have often been categorized as “not compulsory”, “non-work”, “personal” and even “other” travel, and thus shadowed by trips conducted for occupational purposes. In addition, assessing mobility of care also requires providing a clear depiction of short walking trips that are also often dismissed in traditional household travel surveys. One of the reasons for this underestimation is that some surveys are designed to collect data only on long and motorized trips (Saelens et al., 2014). A second cause may be related to the fact that short walking trips (e.g., walking from home to store) are less likely to be reported, perhaps because they are less memorable, and thus more susceptible to recall bias, or because they are considered by the survey respondent as unimportant (Stopher et al., 2007). Lastly, care-related trips are often diluted in other trip motivations such as “visiting” or “leisure” (Sánchez de Madariaga & Zucchini, 2019). Thus, this is limiting our

understanding of a crucial part of daily mobility that is commonly linked to female travel patterns.

2.3. *Determinants of care-related trips*

Although the "mobility of care" concept is rather recent, and despite its methodological constraints, a number of scholars mostly stemming from gender studies have examined different care-motivated trips (Boarnet & Hsu, 2015; Fan, 2017; Hanson, 1981; Lanzendorf, 2010; McDonald, 2005; Motte-Baumvol et al., 2011; Plyushteva & Schwanen, 2018; Rosenbloom, 1987; Scheiner, 2014a; Scheiner & Holz-Rau, 2017; Schwanen, 2007; Taylor et al., 2015). Accordingly, they have also explored the factors or constraints associated with the total amount of such trips, their modal split, and their duration or distance travelled. Within these studies, three main determinants of care-related trips arise: individual, household, and territorial characteristics.

Among individual determinants, gender stands out as the most common key variable in previous studies. In different geographical contexts, previous evidence suggest that care-related trips are more frequently conducted by women, due to the gendered distribution of care-giving and household tasks, specifically evidenced by larger shares among women of trips related to errands or household tasks and daily shopping (Hanson & Hanson, 1991), and escorting children (Motte-Baumvol et al., 2017; Rosenbloom, 1987; Schwanen, 2007). Other individual characteristics that have been found significant include age, educational level or occupational status (Boarnet & Hsu, 2015; Motte-Baumvol et al., 2017; Scheiner, 2014b; Waitt & Harada, 2016).

Household characteristics have also been found relevant for trips related to care, as they take into account the relational dimension of care, that is, the "caring for" others (Fan, 2017). Hence, household composition is frequently used as a proxy to measure the burden of care responsibilities. The presence of minors in the household is evidenced to act as daily travel time constrictor, decreasing the duration of trips (Delclòs-Alió & Miralles-Guasch, 2018). Another study observed how gender differences emerged, as women reported more child-and household-serving trips, regardless of the type of household they belong (i.e. male vs. women breadwinner households) (Taylor et al., 2015). The appearance of child is also associated with a major number of escorting trips (Handy, 1998; Plyushteva & Schwanen, 2018; Schwanen, 2007).

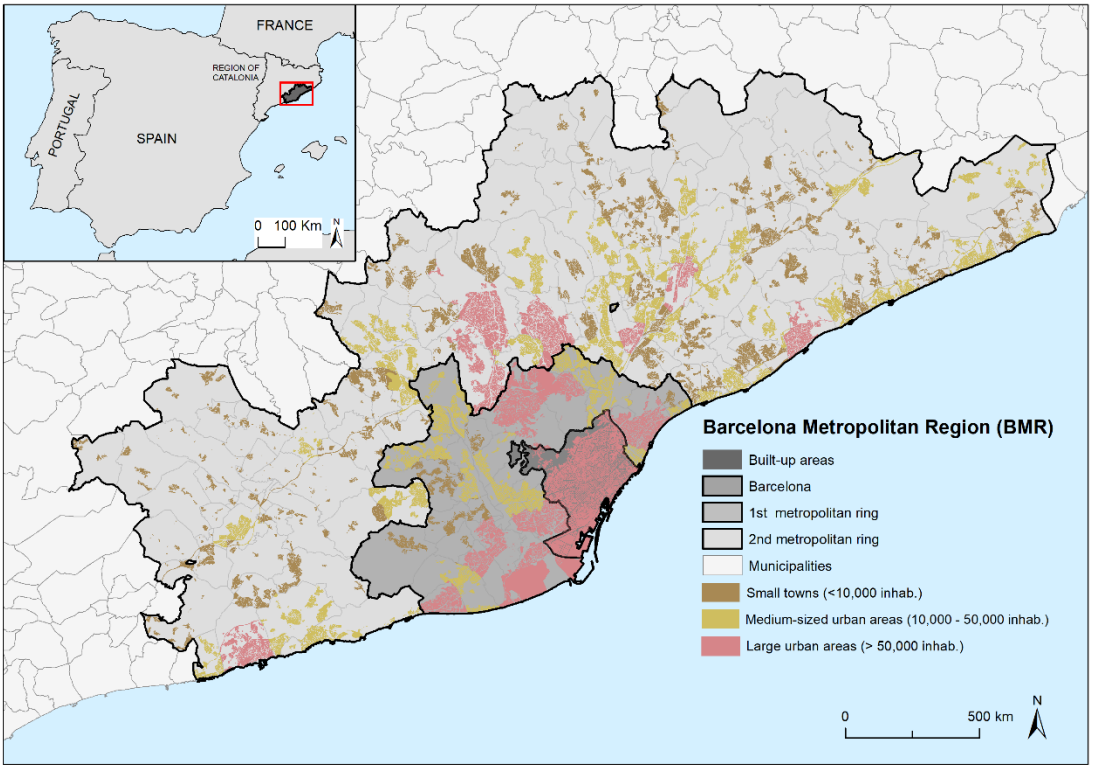
Lastly, there is also some evidence on the association between built environment characteristics and care-related travel patterns. More accessible, mixed, dense and compact environments are usually found to decrease gender differences in travel behaviour, as they provide shorter distances to everyday activities, including those related to care (Boarnet & Hsu, 2015; Miralles-Guasch et al., 2016; Motte-Baumvol et al., 2011). Others however, have argued that density alone is not always associated with a reduction of women care-travel burdens (McDonald, 2005) as the effects of territorial aspects on travel patterns are confounded with other factors such as household responsibilities, resources, perceptions or concerns (Clifton et al., 2005). We also found research that explored the differences in the care-related mobility between different urban types. One study suggested that rural and suburban areas require more chauffeuring from parents to support their children's activities (Tillberg Mattsson, 2002).

3. Methods

3.1. Study area

This study is set in the Barcelona Metropolitan Region (hereafter referred to as BMR). Located in northeast Spain, the BMR is one of the major metropolitan areas in the Mediterranean. It gathers 5.2 million inhabitants, which represents a 10% of the Spanish population. The BMR spreads over an area of approximately 3,000 km^2 and has a radius of 30-45 km. The BMR is structured in three main areas or rings. First, we find the municipality of Barcelona, which represents the core of the metropolitan region and accounts for approximately 1.5 million inhabitants. Second, we find an inner metropolitan ring that consists of a conurbation of 17 municipalities, mostly characterized by compact and high-density development. Third, we find an outer metropolitan ring that includes historical towns and medium-sized cities that present compact and dense features (Marmolejo and Stallbohm 2008), combined with areas of low density and sprawled suburban development (Font, 2007).

Figure 1. The Barcelona Metropolitan Region.



Source: own production.

3.2. Data

The analysis of this study is based on data extracted from the Barcelona Metropolitan Region Workday Mobility Survey (or EMEF in its Catalan acronym, *Enquesta de Mobilitat en Dia Feiner*) (Institut d'Estudis Regionals i Metropolitans (IRMB), 2015). The EMEF is an official annual household travel survey based on computer assisted telephone interviews (CATI). Survey participants are asked to report all information regarding trips conducted in the previous workday (e.g., number of trips, trip purposes, transport modes, trip duration). The survey also collects individual and household characteristics, as well as perceptions and preferences over different transport modes. EMEF surveys the main data source for understanding travel behaviour in the BMR. In 2015, the EMEF collected data from a total of 9,490 individuals older than 16 years old. A relative error of ±1% was assumed, with a confidence level of 95.5%. We focused on individuals that reported at

least one trip (Mobile population) and those that were not directly employed in the transport sector (e.g., bus or truck divers). Sample characteristics are presented in **Table 1**.

Table 1. Sample description.

	Sample N	Population N[a]	%
Total	7,564	3,740,096	100.0
Individual characteristics			
Gender			
Men	3,697	1,828,279	48.9
Women	3,866	1,911,817	51.1
Age			
16-29	1,322	653,796	17.5
30-64	4,676	2,312,346	61.8
65 or more	1,565	773,953	20.7
Educational level			
No studies	225	111,032	3.0
Primary school	2,014	995,689	26.6
Secondary school	2,421	1,196,917	32.0
Superior studies	2,884	1,426,091	38.1
Occupational status			
Student	551	272,344	7.3
Employed	4,030	1,992,634	53.3
House tasks	194	95,911	2.6
Unemployed	787	389,209	10.4
Retired	2,002	989,997	26.5
Household characteristics			
Number of minors in the household			
None	5,117	2,530,365	67.7
One	1,225	605,660	16.2
Two or more	1,222	604,070	16.2
Number of seniors in the household			
None	4,964	2,454,651	65.6
One	1,527	755,231	20.2
Two or more	1,072	530,214	14.2
Territorial characteristics			
Municipal population density (inhabitants/km^2)			
Low (<1,575)	1,533	757,859	20.3
Medium (1,576-9,425)	2,467	1,219,815	32.7
High (> 9,425)	3,538	1,749,553	46.9
Urban area type (per number of inhabitants)			
Small towns (<10,000)	442	218,705	5.8
Medium-sized urban areas (10,000 - 50,000)	1,683	832,093	22.2
Large urban areas (> 50,000)	5,438	2,689,298	71.9

a. Weighted by population weight.

3.3. *Definition of care-related trips*

Since 2006, the EMEF includes a set of trip motivations related to the house maintenance, food provision, visiting and escorting others, personal arrangements and leisure activities. These trips are classified under the category of "personal mobility". Given the lack of consensus on a definition of mobility of care in order to operationalize care trips, we considered a wide notion of what "care" means, including trips based on the different interpretations mentioned in the theoretical framework. Thus, we selected a range of trip purposes included in the EMEF that are susceptible to be interpreted as a care activity, such as those referred to unpaid care labour (i.e. daily shopping, personal errands), including these activities related with an emotional tie (i.e. accompanying other individuals, visiting others), activities corresponding to basic needs (i.e. non-leisure eating, health-related), and finally, those recreational activities related to a "self-care" dimension (i.e. leisure, cultural events, sports, non-daily shopping…). The included trip purposes are are summarized in **Table 2**. Indeed, within this umbrella term, we can identify different sub-groups of care-related trips: *daily shopping*, *accompany others*, *personal care*, and *recreational*.

Table 2. Trip purposes included in Mobility of care.

Mobility of care

Daily shopping	Personal care	Accompany others	Recreational
Daily shopping	Personal errands Eating (non-leisure) Health-related	Accompanying other individuals	Leisure Cultural events Cinema Restaurants Sports Visiting others Non-daily shopping

3.4. *Individual, household, and territorial characteristics*

Individual characteristics correspond to gender, age, educational level, and occupational status. We also included two variables referred to the household structure. Based on what was found in previous literature, we have included the presence of minors (under 18 years old) and seniors (over 85 years old), which may be significant from a relational dimension of daily mobility (Delclòs-Alió & Miralles-Guasch, 2018).

In order to understand differences from a territorial perspective, we used population density and type of urban area of participants' residences. Population density was calculated at the municipal level. Types of urban area correspond to the categorization of municipalities of BMR based on population size. We considered two criteria to define the thresholds. On the one hand, the official limit between rural and urban municipalities, established in Spain at 10,000 inhabitants (INE, 2001). On the other hand, a regional regulation that establishes urban transport as mandatory in municipalities over 50,000 inhabitants (Generalitat de Catalunya, 2003). As a result of these two thresholds, three urban type categories were included in the analysis: small towns (under 10.000 inhabitants), medium-sized urban areas (between 10.000 and 50.000 inhabitants), and large urban areas (over 50.000 inhabitants).

3.5. *Analysis*

The analysis is structured in two parts. First, we offer an overview of the magnitude of mobility of care in the BMR. We described the absolute and relative relevance of care-related trips in the context of overall daily mobility, considering *mobility of care* in general,

how it compared to trips conducted to work and study, and examining care-related specific purposes (*daily shopping*, *accompanying others*, *personal care* and *recreational purposes*) (**Table 3**). We then examined the association between the number of care-related trips conducted per person and individual, household, and territorial characteristics, using a negative binomial regression. Coefficients from the negative binomial model were exponentiated and are interpretable as Incidence Rate Ratios (IRR) and 95% Confidence Intervals (CIs) (**Table 4**). A second step in the analysis was to examine the relationship between care-related trips and transport modes. We first explored the modal split by specific trip purposes and we a used Chi-square test to identify possible bivariate associations (**Table 5**). We then performed a logistic regression to examine the association between the odds of care-related trips being conducted on active modes (walking or cycling), and individual, household, and territorial characteristics. We adjusted one model for all mobility of care trips, and one for each of the specific care-related trip purposes. Coefficients were also exponentiated and are interpretable as Odds Ratios (OR) and 95% Confidence Intervals (CIs) (**Table 6**). Analyses were conducted using IBM SPSS Statistics for Windows, Version 26.0 (Armonk, NY, USA).

4. Results

4.1. An overview of mobility of care

Individuals residing in the BMR in 2015 conducted a total of 6,418,642 care-related trips on a typical weekday (**Table 3**). Mobility of care thus represents a 39.3% of all weekday mobility in the region (over 16 million daily trips), which is more than twice of commuting trips (*work or study*) (16.8%). Moreover, trips related to care are heterogeneously distributed in terms of specific trip purposes. An 8.8% of all weekday trips are conducted for *daily shopping*, a 5.8% for *personal care*, an 8.9% to *accompany others* and a 15.8% correspond to *recreational* trips.

Table 3. Weekday trips in the BMR, by purpose.

	N[a]	**%**
Work or study	2,734,083	16.8
Mobility of care	6,418,642	39.3
Daily shopping	*1,435,270*	*8.8*
Personal care	*947,105*	*5.8*
Accompany others	*1,451,905*	*8.9*
Recreational	*2,584,362*	*15.8*
Return home	7,152,052	43.9
Total	16,307,382	100.0

a. Weighted to population level.

In **Table 4** we report the IRR of care-related trips per person, both overall and for specific trip purposes. In terms of overall mobility of care (**Model 1**), we first observed that care-related trips were significantly more frequent among women (IRR 1.04, 95% CI 1.01 to 1.09), and that they increased with age (IRR 1.03, 95% CI 1.002 to 1.005). Education level and occupational status also showed significant associations with the number of care-related trips: individuals with higher education levels reported a higher number of trips related to care when compared to those with no studies (IRR 1.30 for those with superior studies, 1.27 for those with secondary school, and 1.10 for those with primary

school), while students and employed individuals conducted less care-related trips compared to those unemployed or retired (IRR 0.43 and IRR 0.53, respectively). In terms of household characteristics, individuals with a higher number of minors in the household reported a significantly larger number of care-related trips (IRR 1.21, 95% CI 1.18 to 1.25), while the number of seniors in the household showed a negative association with mobility of care levels (IRR 0.96, 95% CI 0.93 to 0.99). Lastly, in terms of territorial characteristics, population density is negatively associated with the number of trips related to care in the BMR (IRR 0.99, 95% CI 0.991 to 0.993).

Moreover, we observe significant differences in these associations when we focus on specific care-related trip purposes (**Models 2 to 5**). We found key individual variables that consistently showed significant associations with the different types of care-related trips. For example, women significantly reported more trips for *daily shopping*, *personal care* and to *accompany others* (IRR 1.14, IRR 1.12 and IRR 1.25, respectively), while they reported a significantly lower number of *recreational* trips compared to men (IRR 0.90). Age was significantly associated with an increase of *daily shopping*, *recreational*, *accompany others* and *recreational* trips (IRR 1.02, 1.00, 1.01 and 1.00, respectively). In terms of educational level, higher level of studies indicates greater number of trips of *daily shopping* (IRR 1.33 for those with primary school, 1.48 for those with secondary school, and 1.64 for those with superior studies). Occupational status presented differences in all types of care-related trips, showing how students and employed people had significantly lower number of trips (IRR 0.43 and IRR 0.53, respectively) compared to retired people. More specifically, students reported significantly lower numbers of trips for *daily shopping* and *accompany others* (IRR 0.30 and IRR 0.06, respectively) compared with *recreational* trips (IRR 0.70). We also found a positive association of house task occupational status with more trips for *daily shopping* (IRR 1.41).

Household characteristics also showed significant associations with the number of specific care-related trips. The presence of minors in the household was associated with less trips for *personal care* (IRR 0.91) and *recreational* purposes (IRR 0.80), and with more trips to *accompany others* (IRR 2.65). By contrast, the presence of seniors was only associated with a lower number of trips for *daily shopping* (IRR 0.93). Finally, among the significant associations with territorial characteristics, we found that density is associated with a low number of trips for *daily shopping* and *accompanying others* (IRR 0.99 and 0.98, respectively).

Table 4. Incidence rate ratios (IRR) of individual weekday care-related trips associated with individual, household, and territorial characteristics, for overall mobility of care (Model 1) and for specific care-related trip purposes (Models 2 to 5) (N= 7,564).

	Model 1: Mobility of care (overall)	**Model 2: Daily shopping**	**Model 3: Personal care**	**Model 4: Accompany others**	**Model 5: Recreational**
	IRR (95% CI)	IRR (95% CI)	IRR (95% CI)	IRR (95% CI)	IRR (95% CI)
Individual characteristics					
Gender (ref=men)	1.05 (1.012, 1.09)*	1.14 (1.06, 1.24)*	1.12 (1.01, 1.24)*	1.25 (1.12, 1.39)*	0.90 (0.85, 0.96)*
Age	1.03 (1.02, 1.05)*	1.02 (1.01, 1.02)*	1.00 (1.00, 1.01)	1.01 (1.00, 1.01)*	1.00 (0.99, 1.00)*
Educational level (ref=no studies)					
Primary school	1.10 (1.00, 1.22)*	1.33 (1.10, 1.62)*	1.01 (0.77, 1.32)	1.45 (0.87, 2.43)	1.00 (0.86, 1.16)
Secondary school	1.27 (1.15, 1.40)*	1.48 (1.21, 1.80)*	1.14 (0.87, 1.50)	1.86 (1.11, 3.11)*	1.07 (0.91, 1.24)
Superior studies	1.30 (1.18, 1.44)*	1.64 (1.34, 2.00)*	1.36 (1.03, 1.78)*	1.68 (1.00, 2.80)	1.04 (0.89, 1.21)
Occup. status (ref= unemployed or retired)					
Student	0.43 (0.38, 0.48)*	0.30 (0.22, 0.42)*	0.50 (0.37, 0.68)*	0.06 (0.03, 0.12)*	0.70 (0.61, 0.81)*
House tasks	1.00 (0.38, 0.48)	1.41 (1.22, 1.63)*	0.87 (0.66, 1.15)	0.99 (0.72, 1.35)	0.84 (0.69, 1.01)
Employed	0.53 (0.50, 0.56)*	0.57 (0.51, 0.62)*	0.51 (0.45, 0.59)*	0.54 (0.47, 0.61)*	0.53 (0.49, 0.57)*
Household characteristics					
Minors in the household	1.21 (1.18, 1.25)*	1.00 (0.95,1.06)	0.91 (0.84, 0.99)*	2.65 (2.49, 2.82)*	0.80 (0.76, 0.84)*
Seniors in the household	0.96 (0.93, 0.99)*	0.93 (0.87, 0.99)*	0.96 (0.88, 1.05)	0.92 (0.82, 1.04)	1.01 (0.96, 1.06)
Territorial characteristics					
Population density[1] (pop/sq.km)	0.99 (0.991, 0.998)*	0.99 (0.99, 1.00)*	1.01 (1.00, 1.01)	0.98 (0.97, 0.99)*	1.00 (1.00, 1.01)
Urban type (ref= small towns)					
Medium-sized urban areas	1.08 (0.98, 1.19)	1.10 (0.92, 1.32)	1.03 (0.82, 1.30)	1.06 (0.83, 1.36)	1.08 (0.94, 1.24)
Large urban areas	1.07 (0.97, 1.17)	1.07 (0.90, 1.28)	1.02 (0.81, 1.29)	1.16 (0.91, 1.48)	1.01 (0.88, 1.15)

$*p < 0.05$.

4.2. Modal split mobility of care

Approximately half of all weekday trips in the BMR in 2015 were conducted on active means of transport (cycling or walking) (49.0%), followed by private transport (32.5%) and public transport (18.5%) (**Table 5**). Moreover, the use of active mobility was significantly higher for care-related trips compared to work or study trips (61.0% vs 20.8%). By looking at specific care-related trip purposes, the use of active modes were especially high for *daily shopping* trips (80.7%) and, to a lesser extent, for *recreational trips* (61.9%). Conversely, the use of public transport was significantly more common for trips related to *personal care* (25.4%), and private transport was significantly more frequently used for trips conducted to *accompany other people* (42.8%).

Table 5. Modal split of weekday trips in the BMR, by purpose.

	n	Active (%)	Public transport (%)	Private transport (%)	Total (%)
Work or study	2,734,083	20.8*	32.7**	46.5**	100.0
Mobility of care	6,418,642	61.0**	12.5*	26.5*	100.0
Daily shopping	1,435,269	80.7**	4.9*	14.4*	100.0
Personal care	947,105	47.1*	25.4**	27.5*	100.0
Accompany others	1,451,906	48.9	8.3*	42.8**	100.0
Recreational	2,584,362	61.9**	14.4*	23.7*	100.0
Return home	7,152,052	49.6**	18.8**	31.6*	100.0
Total	18,509	49.0	18.5	32.5	100.0

Test: Chi2 sig=000 all categories; adjusted residuals test, corrected.
** significantly higher values
* Significantly lower values

In **Table 6** we report the Odds Ratios (OR) of care-related trips being conducted in active modes of transport. In terms of overall mobility (**Model 7**), we found certain individual characteristics that have a significant association with active trips. Age makes more likely to conduct a care-related trip with an active mode (OR 1.00, 95% CI 1.00 to 1.00), while the chances decline with the increase of educational level (OR 0.94 for those with primary school, 0.88 for those with superior studies). Regarding occupational status, we identified that trips conducted by employed people are less likely to be performed by an active mode (OR 0.88, 95% CI 0.77 to 0.87) compared with those unemployed, retired and in charge of house tasks (OR=1.09, 95% CI 1.02 to 1.16). Moreover, we also found out significantly association with territorial characteristics. Higher density of population contributes to a more probability to choose an active mode for care-relate trips (OR 1.01, 95% CI 1.00 to 1.01). And, in terms of urban type, trips conducted for mobility of care are more likely to be active in medium-sized and large-urban areas (OR 1.25 and 1.27, respectively) than in small towns.

It is also interesting to note at the significant associations for the specific care-purposes (**Models 8 to 11**). Starting with individual characteristics, trips to accompany others are more likely to be active when they are made by women (OR 1.12). By contrast, they are less likely to be active when they are conducted by employed people (OR 0.78) compared to unemployed and retired, and with superior studies (OR 0.60) compared with secondary or primary school educational levels (OR 0.62 and 0.67, respectively). For *accompanying others* purpose, we also identified significant association with

household characteristics. Trips made by people with minors in the household are more likely to be conducted by an active mode (OR 1.17). The presence of seniors also presents a negative significant association with active trips for *daily shopping* purpose (OR 0.96). In terms of territorial characteristics, trips for *personal care*, *accompanying others*, and *recreational* purposes have more chances to be conducted in an active mode in medium-sized (OR 1.54, OR 1.46 and OR 1.19, respectively) and large urban areas (OR 1.55, OR 1.59 and OR 1.18, respectively).

Table 6. Odds Ratios (OR) of weekday care-related trips being conducted in active modes, associated with individual, household, and residential characteristics, for overall mobility of care (Model 7) and for specific care-related trip purposes (Models 8 to 11).

	Model 7: All care-related trips (N=14,894)	**Model 8: Daily shopping trips** (N=3,344)	**Model 9: Personal care trips** (N= 2,124)	**Model 10: Trips to accompany others** (N=3,462)	**Model 11: Recreational trips** (N=5,964)
Individual characteristics					
Gender (ref=male)	1.02 (0.99, 1.05)	0.994 (0.95, 1.03)	1.09 (0.98, 1.20)	1.12 (1.03, 1.21)*	0.97 (0.93, 1.02)
Age	1.00 (1.00, 1.00)*	1.00 (1.00, 1.01)*	1.01 (0.99, 1.00)	0.99 (0.99, 1.13)	1.04 (1.02, 1.06)*
Educational level (ref=no studies)					
Primary school	0.94 (0.88, 0.99)*	0.94 (0.88, 0.99)*	1.00 (0.73, 1.18)	0.72 (0.57, 0.93)*	0.94 (0.87, 1.02)
Secondary school	0.86 (0.81, 0.92)	0.94 (0.87, 1.00)	0.93 (0.73, 1.18)	0.67 (0.52, 0.87)*	0.82 (0.76, 0.90)*
Superior studies	0.82 (0.77, 0.87)*	0.88 (0.82, 0.95)*	0.84 (0.66, 1.07)	0.60 (0.47, 0.79)*	0.79 (0.73, 0.86)*
Occupational status (ref= unemployed or retired)					
Student	0.97 (0.89, 1.06)	0.99 (0.85, 1.17)	0.98 (0.73, 1.30)	0.66 (0.42, 1.03)	0.99 (0.99, 1.12)
House tasks	1.09 (1.02, 1.16)*	0.99 (0.92, 1.08)	1.34 (1.10, 1.64)*	1.10 (0.94, 1.29)	1.02 (0.90, 1.15)
Employed	0.88 (0.84, 0.91)*	0.92 (0.87, 0.96)*	1.01 (0.89, 1.14)	0.78 (0.72, 0.85)*	0.86 (0.81, 0.91)*
Household characteristics					
Number of minors in the household	1.00 (0.98, 1.02)	0.98 (0.95, 1.02)	0.99 (0.93, 1.07)	1.17 (1.12, 1.23)*	0.98 (0.94, 1.02)
Number of seniors in the household	0.99 (0.97, 1.01)	0.96 (0.94, 0.99)*	0.99 (0.92, 1.07)	1.04 (0.95, 1.13)	1.01 (0.96, 1.03)
Territorial characteristics					
Population density (1km pop/sq.km)	1.01 (1.00, 1.01)*	1.01 (1.00, 1.01)*	0.99 (0.98, 1.00)	1.014 (1.00, 1.02)*	1.02 (0.99, 1.00)
Urban type (ref= small towns)					
Medium-sized urban areas	1.25 (1.15, 1.36)*	1.08 (0.96, 1.20)	1.54 (1.12, 2.11)*	1.46 (1.13, 1.88)*	1.19 (1.05, 1.35)*
Large urban areas	1.27 (1.17, 1.38)*	1.10 (0.97, 1.24)	1.55 (1.13, 2.14)*	1.59 (1.23, 2.04)*	1.18 (1.04, 1.33)*

$*p < 0.05$.

5. Discussion and conclusion

In this study we examined what care-related trips represent in the context of everyday mobility, what sociospatial factors are associated with such trips, and what is the use of different transport modes in a Mediterranean urban setting. Our results showed that mobility of care is a central component of everyday mobility in the Barcelona Metropolitan Region, and that is mostly conducted on active modes. Care-related travel patterns vary significantly according to individual, household, and territorial characteristics. Mobility of care is more frequent among women, increases with age and with the presence of dependent individuals in the household, especially with minors. Additionally, denser and larger urban areas are more likely to facilitate the use of active modes for care-related trips. Lastly, our results indicate that to fully examine mobility of care, such trips cannot be considered as part of a homogeneous category, but instead care-related specific purposes need to be accounted for and interpreted.

Mobility of care accounts for approximately 40% of all trips conducted on a weekday, surpassed only be trips conducted to return home. These results are in line with previous evidence (Ravensbergen et al., 2022; Sánchez de Madariaga & Zucchini, 2020), which confirms the need to understand care-related trips as an essential part of everyday life. Additionally, this study sheds light on the determinants of care-related travel patterns. Regarding individual characteristics, we observed how gender still plays a significant role in the number of care-related trips conducted daily. Consistent with previous research (Motte-Baumvol et al., 2017), we identified a gender gap for specific care purposes. Women, as the main caregivers, still report more trips related with house maintenance tasks such as daily shopping and relational care such as accompanying other individuals. Men, however, report a higher rate of trips related to what can be considered as self-care activities, which in this study mainly refers to recreational purposes (Boarnet & Hsu, 2015). We also observed that age and higher educational attainment were associated with a higher number of care-related trips. The higher number of care-related trips associated with elder is related to the experiential significance of mobility (Croucher et al., 2020). For example, in the case of *daily shopping*, in Spain, for seniors, may be seen beyond the provision of basic needs, but as a source of social interaction and physical activity (Díez et al., 2017). In terms of occupational status, results also showed that the number of daily care trips is lower for those who required commuting (students and employed people), compared to those who do not do mandatory commuting (unemployed and retired).

With respect to household characteristics, our results suggest that the presence of dependent individuals seems to increase mobility of care for household members, with significant differences related to seniors and minors. A larger presence of seniors has a positive association with the number of *daily shopping* trips. Research on local food environments conducted by Díez et al. (2017, 2018) found that older adults appreciate buying in specialized stores rather than other retail types such as supermarkets or malls, which is translated in a higher number of trips to meet their shopping needs. On the other hand, the presence of minors has an impact on trips to *accompany others*, duplicating the number of trips for this purpose. This specific result could be explained by social practices that are built upon the culture of parenting, which involves escorting children to school and to other places (Barker, 2011).

Regarding residential characteristics, higher density showed a negative association with the number of care trips, especially those for *accompanying others*. The greater availability of services and public transport options derived from higher levels of urban

compacity allows for higher degrees of individual autonomy (Marquet & Miralles-Guasch, 2015), which in turn makes escorting trips less necessary.

Our results clearly confirm the link between mobility of care and the use of active modes of transport, evidenced by the fact that 60% of care-related trips in the BMR were conducted either on foot or by bike, contrasting with a north-American context, where mobility of care is mainly motorized (Ravensbergen et al., 2022). As a reference, the share of active modes in daily commuting trips in the Barcelona metropolitan area is only around 20% (Autoritat Transport Metropolità, 2019). This evidences that care-related trips mostly take place at the proximity scale, implying short walking trips (Marquet & Miralles-Guasch, 2015). This has both environmental and social implications. From an environmental perspective, mobility of care is clearly associated with a more sustainable travel pattern. Hence, cities that allow for greater degrees of proximity-based mobility would at the same time facilitate trips derived from care-related activities. From a social perspective, the benefits of such mobility are clear in terms of health, social equity, and inclusiveness. Active transport is one of the sources of our daily physical activity, which is considered as essential to maintaining physical and mental health (Ewing et al., 2014). Lastly, walking in particular can be regarded as the most democratic mode of transport, since it grants almost universal accessibility given its low number of barriers of use (Lucas, 2012).

Despite of this general trend, particular attention needs to be paid to the significant differences observed in the modal split across sociodemographic groups, and regarding specific care-related purposes: while almost all *daily shopping* trips were conducted in active modes (80.7%), for trips to *accompany others* the proportion was significatively lower (48.9%). By contrast, such trips presented a greater share of private transport (42.8%) compared to those for *daily shopping* (14.4%). As suggested by previous literature (Mattioli et al., 2016; McDonald, 2005) such significant differences could be explained by the ability to carry objects or other people (mostly dependent individuals) by means of private vehicles. This “cargo-function” of the car in the BMR seems clear for trips to *accompany others*, but not for *daily shopping*. This is probably related with the dense and mixed used structure of Mediterranean cities, which allows to conduct most daily shopping within the neighborhood and at a walkable distance from home (Díez et al., 2018; Garcia et al., 2020; Marquet & Miralles-Guasch, 2014).

Individual, household, and territorial constraints also showed significant differences in terms of the modal split of mobility of care. While previous literature had found an association between active modes and gender (Miralles-Guasch et al., 2016; Scheiner & Holz-Rau, 2017), we did not find such associated specifically among care-related trips. This has relevant implications, as it would suggest that gendered mobility differences are explained by the different typologies of trips on which each gender group engages more often. In our study we only found gender-related differences in terms of trips to accompany others. Consistent to previous research, age was observed to be associated with more chances to conduct care trips on active modes while higher educational level decreases the probability (Ko et al., 2019). In terms of occupational status, employed people is less likely to conduct care-trips with active modes. This could be explained by time constraints. Larger commutes reduce travel time budgets, causing a more frequent use of public and private transport to access all necessary daily activities (Vande Walle & Steenberghen, 2006).

The presence of minors in the household also resulted in significant increases in the number of active care-related trips. This association contrasts with previous evidence where children are often related to driving due to time pressure, which explains a higher

use of car as main transport mode (Dowling, 2000; Maciejewska & Miralles-Guasch, 2019; Motte-Baumvol et al., 2011). Instead, we observe an increase of active trips that may be explained by the relevance of the so-called “third places” (Oldenburg & Brisset, 1982) for minors. These are safe outdoor spaces (e.g., parks, squares or streets per se) different from delimited first and second places (home and school, respectively), where children can be physically active, socially interactive and independently mobile (Carroll et al., 2015). These third places, commonly situated nearby the residence, act as restrainers of daily mobility, thus, giving more relevance to proximity walking trips.

Finally, regarding territorial characteristics, density and city size are also associated with a larger relevance of active trips. These results that have been repeatedly validated in prior literature that examines the relationship between built environment with either walking for transport or overall physical activity, pointing at density, diversity, and accessibility as driving factors of such activities (Smith et al., 2017).

All in all, this paper contributes to travel behavior studies mainly in two ways. Firstly, it sheds light to the relevance of care-related trips in the context of daily mobility. The “power of naming”, that is, of conceptualizing a daily reality (Law, 1999), helps to avoid viewing care as a marginal issue, and instead, opens the opportunity to place care in the heart of urban transport analysis and policies. Consequently, it creates the possibility to challenge the hegemonic male-oriented planning tradition of mobility systems, which have structured transport for the good of productive sphere, focused into commuting (Valdivia, 2018). Secondly, by both quantifying mobility of care as a whole and examining specific care purposes we aim to offer a better understanding of the care-related mobilities that may inform urban policies aiming to support care-related trips. In a general level, by promoting compact and mixed urban environments where daily needs can be satisfied in the short-range scale, as recently highlighted by current planning initiatives such as the 15-minute city paradigm (Moreno et al., 2021). In addition, these results could also inform specific transport strategies such as public policies aimed at accompanying others, for example those aimed at improving safety in trips to school. These transformations would be expected to have a positive impact also in terms of gender equity, as they promote a more equitable distribution of caring tasks at the household level (Lo & Houston, 2018), while at the same time contributing to transition towards a more sustainable transport system (Kronsell et al., 2016).

Our study is not without limitations that can inform future studies on the topic. The survey data used in this paper was not specifically gathered with a focus on care-related activities, thus, having several implications. First, inaccuracies in the self-reporting of care-trips are to be assumed, particularly in purpose categories such as “visiting others” or “recreational” trips, where it is uncertain if the activity had a clear care-implication. Secondly, the categories inaccuracy has implications in a theoretical sense, as we had to consider a wide notion of “care” for operationalizing mobility of care, while other authors argue a more restrictive definition. Finally, this lack of a care-sensitive perspective in the survey design is translated in a range of missing variables that would have been interesting to consider when analyzing mobility of care, such as additional information on trip purposes, about companions, carried objects or trip chaining. This is an important issue not only for future studies but also for transit agencies and should be considered in future research on mobility of care also from qualitative perspectives.

We expect this study to contribute to understanding how care operates through everyday mobility, by accounting for care-related trips and exploring their relationship with a set of key sociospatial factors. The findings provided in this study can serve as insights for future studies that aim to expand the understanding of what mobility of care consists of

what unequal social relationships it is related to, which can inform public policies that work to advance towards more inclusive and caring cities.

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