MSc Programme in Urban Management and Development

Rotterdam, the Netherlands

August 2024

Mobility of Care in the Netherlands: Characteristics and Impacts on Travel Mode Choice

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Report number:1935

UMD2023-24

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Summary

‘‘Mobility of Care’’ refers to everyday travel done to perform care labor such as escorting dependents to school or appointments and shopping for household needs. Over the past decade, research has begun to examine how individuals and households divide Mobility of Care responsibilities and how this travel is different from other travel motivations, often through interviews and travel diaries. However, little research to date has attempted to quantify Mobility of Care relative to other major types of travel, or to understand how it impacts the travel modes that individuals choose. In fact, most travel surveys do not even measure “care” as a potential travel purpose. The limited studies to have addressed these issues so far find that Mobility of Care is a highly prevalent travel motivation that is performed disproportionately by women and frequently reliant on the car. The Netherlands, where cycling and walking make up a large proportion of daily mobility despite high levels of car ownership, presents a useful case in which to investigate these questions. This paper presents the results of an exploratory analysis of Mobility of Care in the Netherlands based on the 2022 Dutch National Travel Survey. Specifically, this paper develops a classification of Mobility of Care by recategorizing the travel purposes measured in the survey and then exploring who completes this type of travel and how. This is done with a focus on gender differences. A regression analysis is then done to study the extent to which Mobility of Care is a predictor of travel mode choice.

Findings of this analysis indicate that Mobility of Care comprises the largest proportion of adults’ daily trips, more prevalent than travel for employment or leisure. Furthermore, women complete a greater proportion of Mobility of Care than men, a difference that holds whether or not they are employed outside the household and that increases for women with more children. Mobility of Care trips tend to be shorter than trips for other purposes and are more likely to be conducted in trip chains. Finally, Mobility of Care trips are taken most often by car and are less likely than trip for other purposes to be taken by bicycle or on foot, even considering the Netherlands’ impressive investment in cycling infrastructure and walkable urban spaces. Overall, the results highlight the importance of considering Mobility of Care as a category of travel in its own right and specifically addressing the requirements and characteristics of this type of travel when conducting transportation planning.

Keywords

Mobility of Care, Travel Behavior, Transportation Planning, Gender, The Netherlands

Acknowledgements

Thank you to my professors at IHS for teaching me so much about the complex dynamics of cities, and especially to Drs. Anitra Baliga and Paula Nagler for their help shaping the direction of this thesis. Thank you to my parents for all of your support during the writing process. And thank you to Steph for your writing advice, your support, and for getting me interested in care and transportation in the first place.

Foreword

I have been interested in transportation policy and promoting active transportation for a long time. I decided to pursue a master's in the Netherlands to learn from and experience the higher investment in and usage of bicycling, as well as public transportation modes, for daily life there. I first came across issues of gender, care, and mobility in Leslie Kern's book *Feminist City* (2020). This got me interested in looking at transportation through a feminist lens and considering how transportation policies can have varied effects on different groups. In particular, this issue interested me because it is highly sensitive to the way that planners collect data and define objectives in ways that can build-in hidden biases. As we learned in Urban Complexity at the beginning of the UMD program, certain systems can appear permanent or unquestionable until the problem definition itself is questioned. Redefining the problem of mobility is what the concept of Mobility of Care can do.

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Abbreviations

Abbreviation	Full Form
CBS	*Centraal Bureau voor de Statistiek* (Central Bureau for Statistics, Government of the Netherlands)
IHS	Institute for Housing and Urban Development Studies
ODiN	*Onderweg in Nederland* (Dutch National Travel Survey)

1. Introduction

Transportation planners and scholars have too often neglect daily travel motivated by a desire to care for others. Coined by Sánchez de Madariaga (2009), ‘‘Mobility of Care’’ refers to all of the everyday travel “linked to social reproduction” (p. 590). The term was developed to conceptualize the travel involved in reproductive, care labor as a counterweight to the travel involved in traditional, productive labor (especially commuting) as well as other major travel motivations (Sánchez de Madariaga, 2009). While historically care labor has generally not been remunerative, it is still work that involves significant time, effort, and skill (Duffy, 2013; Hanson, 2010). Transportation planning and policies invest significant resources in facilitating economic productivity through physical infrastructure systems, but the infrastructure needed to facilitate care work is often neglected or underprioritized, despite both types of labor being critical to support everyday life (Sánchez de Madariaga, 2009). Care work involves frequent and essential travel responsibilities such as escorting children to school, shopping for household goods, or traveling to care for elderly relatives, but such trips are rarely understood as being part of the same category—rather these trips are viewed by planners and laypeople alike as separate, niche travel categories that are less crucial than travel for paid work.

Mobility of Care has only recently emerged as a subject of mobility research, but it expands upon a large body of literature on travel for household needs and social reproduction (Hanson 1980; Hanson, 2010; Hayden, 1980; Law, 1999). The concept of Mobility of Care as an umbrella category serves to unite the various types of household-serving trips, previously the study of separate research, and conceptualize the full impact of travel for all aspects of care. Though it is important to consider the different types of Mobility of Care trips and their unique needs, viewing care travel as a single category underscores its scale and relevance as a component of daily mobility. Several studies have found that Mobility of Care and commuting account for similar numbers of trips (Gomez-Varo et al., 2023; Ravensbergen et al., 2022; Sánchez de Madariaga & Zucchini, 2020). This perspective makes the case for increased attention to and investment in the needs of care travel. However, more research is needed to clarify this finding.

Mobility of Care also warrants consideration by planners and policymakers who aim to reduce the carbon footprint of urban transportation by discouraging driving in favor of more sustainable travel modes. Preliminary research on Mobility of Care has found that driving may be relatively more common for such trips than for other trip purposes, while public transit, walking, or cycling may be relatively less common (Craig & Van Tienoven, 2019; Ravensbergen et al., 2022; Sánchez de Madariaga & Zucchini, 2020). This may be because travelers are more likely to undertake Mobility of Care trips either while burdened by carrying items or accompanied by dependents with limited mobility (Sánchez de Madariaga & Zucchini, 2020). Therefore, understanding and planning for the unique requirements of Mobility of Care is highly relevant to any sustainable transportation initiative.

Additionally, Mobility of Care is important to consider for transportation equity. Care labor and travel responsibilities are deeply intertwined with gender norms and inequities that constrain women’s mobility (Hanson, 2010; Levy, 2013; Root et al., 2000; Rubin, 1975). Considerable past research has shown that various household-serving travel tasks are more disproportionately accomplished by women (Boarnet & Hsu, 2015; Dobbs, 2007; Lanzendorf, 2010; Mauch & Taylor, 1997), and this trend has also been found by studies analyzing Mobility of Care as a unified category (Craig & Van Tienoven, 2019; Gomez-Varo et al., 2023; Ravensbergen et al., 2022; Sánchez de Madariaga & Zucchini, 2020). Accordingly, better understanding and planning for Mobility of Care is an important part of making urban planning more gender equal.

One of the current obstacles to understanding Mobility of Care is that typical travel surveys do not often allow it to be measured properly. Sánchez de Madariaga argues that most trips that are made for care are mislabeled under other categories such as "visiting," "shopping," or "leisure" (2009). Furthermore, these categories are imprecise and do not distinguish between tasks dedicated to care and those that are not. To make matters worse, surveys are not always precise enough to distinguish chained trips with multiple stops that may serve different purposes or may not include very short trips (e.g. less than 15 min or 1km), meaning that Mobility of Care may often be subsumed into other categories like commuting or invisible within a group of unreported short trips (Sánchez de Madariaga, 2009). This means that transportation planning decisions that are made based on travel survey data are unable to consider Mobility of Care. In general, not enough research has been done quantifying Mobility of Care and its impacts. Furthermore, what research has been done in this area has not been done in a context, such as the Netherlands, with widespread access and investment in many diverse travel modes.

This paper addresses the question: *How does Mobility of Care in the Netherlands compare to other travel motivations in terms of prevalence of trips, characteristics of trips, and traveler demographics?* This question is explored through a quantitative analysis of the 2022 Dutch National Travel Survey, an annual survey conducted by the Dutch government. Studying Mobility of Care in the Netherlands, where it has not been measured before, is useful to understand how this travel is accomplished in a context where many trips are made by bicycle or on foot. Data collection in the Netherlands at a national scale enables a broad study scope beyond a single metropolitan area. Furthermore, the travel survey measures all trips, even very short ones, on multiple metrics including travel time and distance covered, providing an unusually high level of detail for analysis.

Mobility of Care in the Netherlands is found to represent either the most common or second most common trip purpose (depending on measurement methodology), and Mobility of Care trips differ from other types of trips in several important ways. Trips made for care are generally shorter than other trip purposes in both time and distance covered but are more likely to be chained together with other trips. They are more evenly distributed throughout the day than other trip types. Mobility of Care trips are also more likely than other trip types to utilize a car as the main travel mode, and less likely to be made on a bicycle or on foot. Additionally, the demographics of travelers making Mobility of Care trips differ from other trip types. An increase in care travel responsibilities is associated with living with a spouse or partner and living with children and is also associated with a decreased chance of working for pay outside the household. Women generally have more care travel responsibilities than men, regardless of whether they are employed or whether they live with children. Overall, Mobility of Care not only accounts for a significant proportion of all daily trips made in the Netherlands, but it has unique characteristics and is closely related to issues of gender in equality in such a way as to make it an important focus for urban planners and policymakers.

This paper presents a literature review on the topic of mobility theories, care labor, and Mobility of Care, followed by a description of the data and analysis methodologies used in the study. The results section first discusses key characteristics of Mobility of Care trips, followed by characteristics of travelers for Mobility of Care and the relationship between Mobility of Care and travel mode choice.

2. Literature review and hypotheses

2.1 New mobilities paradigm

The spatial turn in the social sciences has been accompanied by a new mobilities paradigm that seeks to expand the concept of mobility from the ways people and goods move in space to a consideration of how that movement is shaped by the relationships of power that underlie social systems (Hannam et al., 2006). This paradigm puts "an emphasis on the relation between human mobilities and immobilities and the unequal power relations which unevenly distribute the potential for mobility" (Hannam et al., 2006, p. 15). It requires a recognition that individual identities, and relative positions within structures of power, inform how our movements through space are enabled or constrained. Mobility cannot be studied without considering how systems of social norms impact the choices available to us as individuals (Cresswell, 2006). Mobility is shaped by individual identities, but it also shapes them. Law (1999) and Hanson (2010), among others, have shown that gender and mobility are co-constructive; gendered social norms determine what movement is acceptable, and the different experiences of mobility influence the expression of gender.

Societal transportation systems are informed by individual mobility needs to travel through space but are also constructed within the context of social power relations. Transportation planning has historically been presented as scientific and apolitical, but the planning process is shaped by embedded preferences and norms, leading to hidden bias (Dumbaugh et al., 2014). The result is "a transport system that does not reflect the needs of the majority of urban dwellers, offering a range of transport options that are accessible only to some and thus does not provide the basis for making optimal travel choices" (Levy, 2013, p. 49). The planning of the built environment and of systems for transportation fundamentally frames who can access urban space, in turn structuring the mobility of individuals in the city. In order to facilitate each citizen's right to appropriate urban space, Levy (2013) calls for better understanding of the ways that individual travel choices are shaped by existing power structures and the built-in biases of the transportation system in order to center the "political act" of individual travel choices in the planning process (p. 52).

One important source of the bias inherent in transport systems is the universalization of the male breadwinner as a default traveler. Historically, the travel needs of commuters (assumed to be men) were prioritized, and consequently research in other mobility issues was overshadowed by travel for paid employment (Law, 1999, p. 570). Facilitating economic production has long been seen as a primary motivation of transportation planning, but the reproductive labor involved in caring for dependents, traditionally seen as tied to the domestic sphere, is rarely considered. Reproductive labor is "vulnerable to intersecting sources of inequality and degradation" as it is socially undervalued and creates disproportionate burdens for individuals with less power (Duffy, 2013, p. 148). By extension, the travel required to perform care is also undervalued and deprioritized. However, studying how such trips are accomplished is crucial to better understand the relationship between personal mobilities and the greater transportation system so that future planners can challenge inequitable values and priorities.

2.2 Mobility of Care

Travel for reproductive labor has only recently been recognized as an important type of daily travel. Ines Sánchez de Madariaga (2009) coined the term "Mobility of Care" as an umbrella category for any trip made to perform care labor, such as escorting children or adult dependents

to appointments, grocery shopping for the household, or traveling to a friend or relative's house to care for them. Viewing these trips as a single category is beneficial to illustrate the impact of care labor as a motivator of travel, and to understand the varied but interconnected ways that the norms of social reproduction impact personal mobilities. There has recently been an increase in research utilizing the concept of Mobility of Care to analyze how the unique requirements of this type of travel frequently made either accompanied by dependents (who may have limited mobility themselves) or encumbered with household goods creates different personal mobilities.

Research has shown that while almost all adults perform some Mobility of Care, certain groups have disproportionate care travel responsibilities such as women (Fong and Shaw, 2024; Gilow, 2020; Maciejewska and Miralles-Guasch, 2019; Montoya-Robledo et al., 2020; Orjuela and Schwanen, 2022; Plyushteva and Schwanen, 2018; Sersli et al., 2020; Taylor et al., 2015), the poor (Jirón and Gómez 2018; Orjuela and Schwanen, 2023), and seniors (Croucher et al., 2020; Plyushteva and Schwanen, 2018). Most of this research has focused on the gender gap in care travel, which remains large even as the gender gap in paid employment has generally fallen (Fan, 2017). Additional studies have shown that even women who work for pay outside of the household take on more Mobility of Care responsibility than their male partners (Boarnet & Hsu, 2015; Fan, 2017; Grant-Smith et al., 2015; Han et al., 2019). These studies make the case that personal characteristics like age, income, and particularly gender are key predictors of an individual's care travel burden.

At the same time, Mobility of Care has been shown to impact overall mobility in a variety of ways because it has unique requirements compared to other types of travel, requirements that are not always planned for in the transportation system. For one, care responsibilities may constrain travel for other purposes like commuting. Research on geographies of employment have long observed that women tend to have shorter commutes and be employed closer to home than men (Fan, 2017; Hanson & Johnston, 1985; Law, 1999), and several studies argue that this results partly from women needing to juggle paid labor and unpaid care labor and thus combine commuting with Mobility of Care, necessitating shorter trips to work (Han et al., 2019; McQuaid & Chen, 2012; Taylor et al. 2015). Mobility of Care has also been shown to be less compatible with certain travel modes. Several studies have found that travelers, especially women, prefer not to cycle or use public transport for care-related trips due to inconvenience of routes, time lost frequently waiting, or safety concerns regarding travel with children or extra baggage (Emond et al., 2009; Heim Lafrombois, 2019; Prati, 2018; Ravensbergen et al., 2020; Sersli et al., 2020). Other studies have shown that driving is preferred to public transport for care-related travel because of both safety and the added flexibility required for care trips (Hodgson, 2012; Maciejewska & Miralles-Guasch, 2019; Villafuerte-Diaz et al., 2023). Mobility of Care is not necessarily the primary determinant of individual mobilities, but it is an important, commonly overlooked factor that is often out of an individual's personal control.

Recent studies in Canada (Ravensbergen et al., 2022), Spain (Gómez-Varo et al., 2023; Sánchez de Madariaga & Zucchini, 2020) and Colombia (Murillo-Munar et al., 2023) have shown that Mobility of Care can be quantified at a regional level to understand its overall scale as a travel motivation and pinpoint its impact on the overall transportation system These studies all found that care travel is comparable to commuting in terms of the number of daily trips, and more prevalent than commuting for female travelers. One other study by Craig and Van Tienoven (2019) compared Mobility of Care at a national scale in Finland, the UK, Spain, and Australia, and argued that it is systematically varies across cultures based on familial norms

and roles. However, apart from these exceptions, relatively little research has attempted to quantify Mobility of Care relative to other types of travel.

Furthermore, when quantitative analysis of Mobility of Care has been conducted, it has generally focused more heavily on *who* makes such trips rather than on *how* they are made. In other words, less research has asked how Mobility of Care interacts with choices of travel mode within the greater transportation system. Studies that have investigated mode choices for care travel have found that there are important differences in the modes used for Mobility of Care and the modes used for other purposes such as travel for paid employment, education, or leisure activities (Craig & Van Tienoven, 2019; Gómez-Varo et al., 2023; Maciejewska and Miralles-Guasch, 2019; Murillo-Munar et al, 2023; Ravensbergen et al, 2022; Scheiner & Holz-Rau, 2017). While these studies have identified some common themes, such as an increased likelihood of Mobility of Care travel to rely on more flexible modes instead of fixed-route transportation, this relationship will depend on local geographics and social systems. For instance, while Ravensbergen et al (2022) found that care travel in Montreal, Canada was most associated with driving more than other trip purposes were, Murillo-Munar (2023) found that care travel in Bogota, Colombia was primarily done on foot and Gomez-Varo et al. (2023) found that care travel in Barcelona, Spain was mostly done by active modes (i.e. walking or cycling). These findings provide insight into the ways that different levels of urban density, car access, public transportation investment, climate, and income can impact the travel choices of individuals for Mobility of Care.

That said, studies have found contradictory results. For example, Gomez-Varo et al.'s (2023) findings of prevalent active mode use for Mobility of Care in Barcelona contradicts earlier findings from Maciejewska & Miralles-Guasch (2019) that Barcelonians prefer to drive for care travel. We do not yet understand of how predictably, if at all, patterns of Mobility of Care vary spatially, much less how they will be affected by future changes to our transportation systems. As cities around the world seek to reduce the carbon footprint of daily travel and create more sustainable transportation systems, more research is needed to understand how Mobility of Care shapes travelers' incentives to use different travel modes.

This thesis addresses the gap in current research by using survey data to quantify Mobility of Care in the Netherlands at a national scale. It takes advantage of the detailed data available to compare multiple metrics for measuring the intensity of travel and of Mobility of Care as a travel purpose. It also focuses particularly on the travel modes used for Mobility of Care. This relationship has yet to be analyzed in a context that combines well-developed public transportation systems with a high reliance on bicycle travel such as the Netherlands. As a routine destination for foreign planners to study urban design best-practices to emulate back home (Pojani & Stead, 2014), the Netherlands is an important case study to understand Mobility of Care in the future. Unusually by global standards, cycling trips in the country are both extremely prevalent—at approximately 25-30% of all trips—and roughly gender-equal (at least when considering commuting trips) (Eyer and Ferreira, 2015; Fishman, 2015; Harms et al., 2014; Ton et al., 2019). These studies have found that a wide range of travel modes are well used in the Netherlands for many types of trips, meaning individuals can be assumed to select the mode that best serves their needs for a given trip, rather than being forced to choose the only mode available to them. Furthermore, the Netherlands is ranked the 5th most gender-equal country in the world in based on the United Nations Development Program's (2024) Gender Inequality Index. Dutch women therefore face fewer constraints to their daily mobility due to gendered power structures, meaning that associations of care travel and mode choice that are observed in the Netherlands are more likely to stem from properties of Mobility of

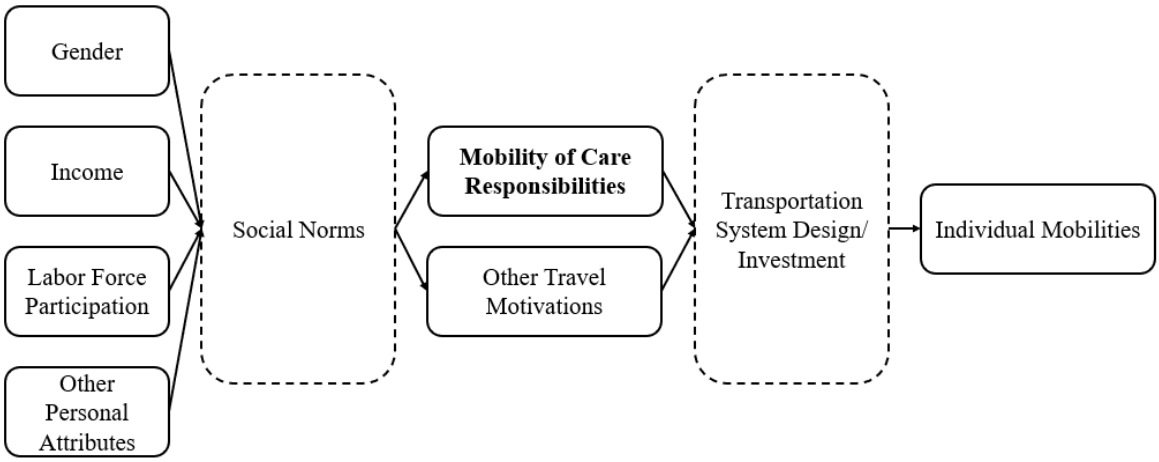
Care itself than to be general effects of patriarchal social arrangements. All told, this thesis is positioned to address the gap in knowledge of the characteristics of Mobility of Care in a relatively gender-equal society and the relationship between Mobility of Care and mode choice in an environment of multiple, accessible transportation options.

2.3 Conceptual framework

Individual mobilities are shaped by the constraining or enabling influence of the overall transportation system on an individual's desire or need to visit certain spaces (Cresswell, 2006). Where an individual needs or wants to go constitutes their travel motivation. Different travel motivations are easier or harder to accomplish within the transportation system due to transportation planning decisions having to do with who and what is able to move where and when and in what manner (Cresswell, 2006). This paper argues that Mobility of Care responsibilities represent a significant determinant of travel motivation that, due to being historically understudied and overlooked, are not always well facilitated by the Dutch transportation system.

At the same time, Mobility of Care responsibilities do not exist within a vacuum, but like all travel motivations they are informed by personal characteristics as transformed by social norms and power structures (Law, 1999; Sánchez de Madariaga, 2009). While day-to-day care responsibilities are unique to each individual, they predictably vary based on characteristics such as gender, income, labor force participation, and other personal attributes. Accordingly, understanding Mobility of Care requires conceptualizing it as both a dependent variable shaped by personal characteristics and social norms, and as an independent variable determining individual mobility through the constraints it faces in the physical transportation system. This relationship is illustrated in Figure 1, below. Mobility of Care is an example of what Cresswell calls the "social baggage" that shapes an individual's mobility (2006, p. 264). This paper investigates Mobility of Care both as an important travel motivation that is influenced by social norms and as a driver of individual mobilities through its interaction with the overall transportation system.

Figure 1. Conceptual Framework



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3. Research design and methodology

3.1 Data

To measure the scope and importance of Mobility of Care as a travel motivation in the Netherlands relative to other travel purposes, this study employs a large, quantitative, secondary dataset of randomly sampled daily trips. The data are collected and compiled by the Dutch government. While other studies have utilized interviews or personal travel diaries to study individual Mobility of Care patterns and motivations, using survey data enables Mobility of Care trips to be quantified at a national scale and therefore allows broad patterns to be identified.

This paper uses data collected by the *Centraal Bureau voor de Statistiek* (CBS) through the Dutch National Travel Survey, (or ODiN in its Dutch acronym, *Onderweg in Nederland*) (CBS, 2023). CBS provided permission to use this dataset for this analysis. The ODiN has been conducted annually since 2018 and is designed to measure "travel behavior of residents of the Netherlands that takes place every day" (CBS, 2023). Residents of the Netherlands (including non-citizen residents) who are randomly selected to participate in the survey are assigned a specific day and asked to report all of their movements outside of their residence on that day via an internet survey, including where they went, how they traveled, and why. Respondents also provide household information such as ownership of automobiles or electric bicycles, household income, and educational attainment. Additionally, respondents can enter a raffle for a cash prize as an incentive to complete the survey, increasing response rates. While the ODiN survey have a certain non-response rate, the design takes this into account such that the randomized sample can be assumed to be representative of the Dutch population and their overall travel patterns.

The most recent ODiN data currently available as of June 2024 are from 2022. Using 2022 data provides the most up-to-date observation of daily travel in the Netherlands, including the reshaping of travel patterns due to the COVID-19 pandemic, while mostly excluding the disruptive effects of pandemic lockdowns and travel restrictions. These measures were lifted in the Netherlands in January 2022.

The ODiN dataset was chosen for this study for two reasons. First, the dataset contains a wide variety of household- and trip-based variables, including the modes of transportation used and the trip motivations, meaning that it is suitable to use for analysis of the relationship between Mobility of Care and the choice of transportation mode. The fact that the data are collected for the entirety of the Netherlands and over the course of a full calendar year offers an advantage compared to other travel surveys often conducted at the level of a single metropolitan area or during only a few (usually summer) months. This means that the ODiN includes valuable geographic and seasonal variation. The ODiN also collects data on all trips (regardless of length or purpose) and provides multiple metrics such as time and distance traveled. Second, the ODiN survey is conducted on behalf of the Dutch Ministry of Infrastructure and Water Management, which uses the data to inform transportation policy throughout the Netherlands. Studying Mobility of Care with the same dataset that is used to inform planning of the Dutch transportation systems makes it possible to demonstrate how paying greater attention to Mobility of Care could alter planning priorities.

The ODiN samples respondents who are as young as 6-years-old (who may respond with the assistance of a parent or guardian). This analysis considers only trips made by adults, and therefore trips made by respondents under the age of 18 are excluded. Additionally, this analysis considers only trips made after January 16, 2022, the date when COVID-19 lockdowns

were officially lifted in the Netherlands. This limits observations to generally normal travel conditions, such as are expected to continue in the near future.

3.2 Operationalization

Mobility of Care remains a relatively new concept within the mobility literature, and transportation surveys in most countries, including the ODiN in the Netherlands, do not directly measure it. Accordingly, this analysis estimates Mobility of Care from the available survey data to conduct an exploratory analysis of care travel in the Netherlands. This enables discussion of its prevalence as a travel category and significant differences relative to other types of travel. Many studies of care-related travel have studied specific subcategories such as journeys accompanying children to school, but recently several studies have attempted a holistic estimation of Mobility of Care.

Sánchez de Madariaga and Zucchini undertook such a study of Mobility of Care in 2020. They conducted a survey of adults in Madrid, Spain to determine how much of their daily travel consists of Mobility of Care, and then compared their results to data from a travel survey conducted in the city by the Spanish government. Using their care-specific survey, they developed a methodology to extrapolate a category of Mobility of Care based on proportions of trips within other categories (such as escorting children, shopping, health, and social visits), which can be used in cases when travel surveys do not explicitly ask about care-related travel (Sánchez de Madariaga & Zucchini, 2020). This methodology has been replicated by other studies in Montreal, Canada (Ravensbergen et al., 2022), Barcelona, Spain (Gómez-Varo et al., 2023), and Bogotá, Colombia (Murillo-Munar et al., 2023).

The calculation of Mobility of Care as a travel category has varied across studies. Given that the literature on care and mobility is still emerging, and travel surveys do not generally include care as a category of trip purpose that respondents could select themselves, functional definitions of Mobility of Care have differed based on the data available. This paper seeks to provide as broad a picture as possible of Mobility of Care in the Netherlands, and accordingly it compares four different calculation methodologies to examine any potential differences between them.

At its most basic level, Mobility of Care has been defined as travel that is not done for the purpose of paid employment or personal education (e.g. Gomez Varo et al, 2023). This definition includes not only travel to provide care to dependents, but also travel for self-care, and therefore does not separate leisure or recreational activities from categories such as household shopping or health travel. This paper categorizes this definition of Mobility of Care as Level 1.

While self-care has often been considered a type of care labor, Mobility of Care has more commonly been used to specifically describe care for dependents and the household at-large. Many studies on Mobility of Care have therefore excluded leisure and recreational activities (e.g. Craig & Van Tienoven, 2019). This paper categorizes this methodology, which excludes not only travel for paid employment and personal education but also for self-care activities like sports, hobbies, and general leisure, as Mobility of Care Level 2.

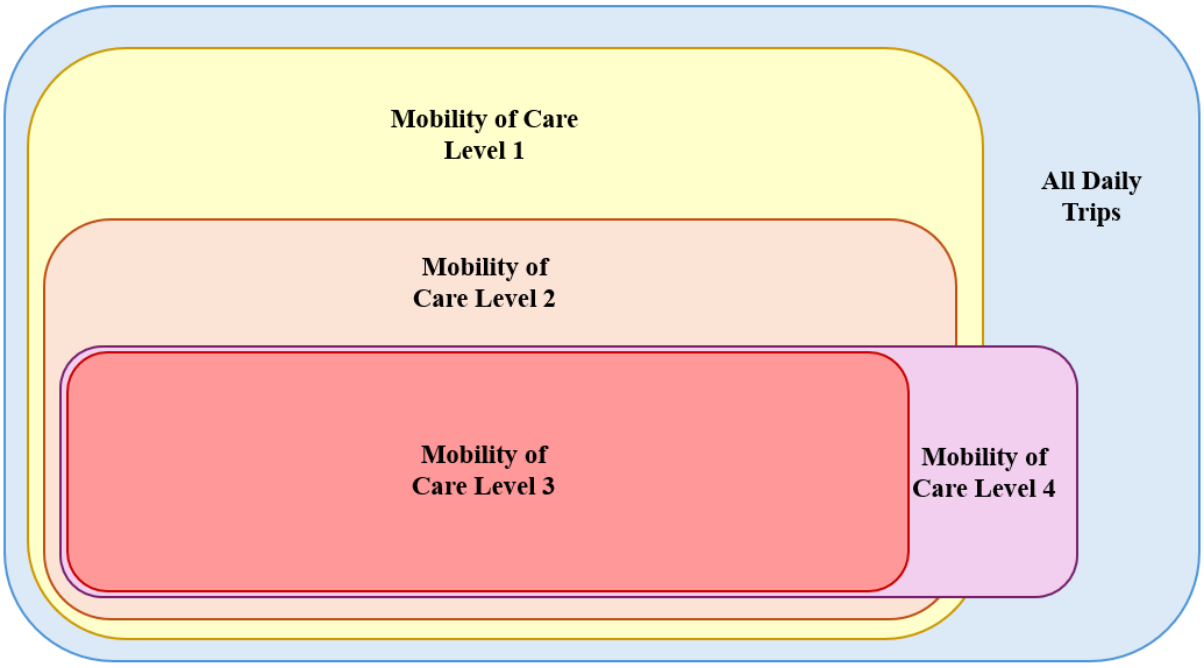
Sánchez de Madariaga and Zucchini (2020) identify several common travel purposes frequently included in transportation surveys that are difficult to parse between care travel and non-care travel. Categories such as shopping and visiting clearly contain overlaps. For instance, shopping could describe both shopping for household needs such as food and shopping for pleasure, while respondents could visit someone merely as a social call or to provide care.

Therefore, they created a methodology to deal with these overlapping categories by considering 2/3 of "shopping" trips and 1/3 of "visiting" trips as care labor, based on their 2020 study of Madrid, Spain (Sanchez de Madariaga & Zucchini, 2020). They additionally include under Mobility of Care all trips made for the purpose of health or escorting someone, but exclude trips for leisure, recreation, paid employment, and personal education (Sanchez de Madariaga & Zucchini, 2020). This methodology has been recently replicated, such as in Ravensbergen et al.'s (2022) study of Montreal, Canada. This paper categorizes this methodology as Mobility of Care Level 3.

Finally, several papers (Montoya-Robledo et al., 2020; Sánchez de Madariaga, 2009; Sánchez de Madariaga & Zucchini, 2020; Ravensbergen et al., 2022) have reflected that it is not always possible to identify care trips based only on the reported trip purpose. People may perform care in the process of traveling with a dependent for a variety of reasons, even if they are not specifically escorting that person. For instance, while general recreation trips are not usually considered to be care-related, a recreation trip taken with a young child could be considered Mobility of Care. The ODiN dataset does not report how many people the respondent travelled with for every trip. However, it does measure whether each trip was accompanied by at least one child under the age of 6. Therefore, the final tested methodology to calculate Mobility of Care, Level 4, includes all trips that fall under Sánchez de Madariaga and Zucchini's (2020) methodology (defined here as Level 3) as well as any other trips that are accompanied by at least one child under 6 years old.

The relative breadth of each of the four Mobility of Care calculation methodologies is illustrated in Figure 2 below (not to scale).

Figure 2. Mobility of Care Calculation Methodologies



Source: author

This paper quantifies Mobility of Care as a travel purpose in the Netherlands. There are multiple metrics that could be used to measure the importance of a given travel motivation. Many papers studying travel behavior measure the number of trips made for a given purpose (e.g. Ravensbergen et al., 2022). The ODiN survey counts each trip as one observation, making it easy to analyse travel on a by-trip basis. However, trips are not uniform. A more relevant

measurement of travel from the perspective of the traveler is the time spent on each trip or the total time spent traveling for each category over the course of a day. Several studies that utilize time-use surveys measure travel in terms of time spent (e.g. Craig & Van Tienoven, 2019; Mauch & Taylor, 1997). ODiN respondents report the total time they took to make each journey of the reporting day. Finally, from a transportation planner's perspective, another useful metric might be trip distance, or the total distance traveled per day for each category, as it more closely reflects a trip's demands on the greater transportation system. ODiN respondents also report the (approximate) distance they covered during each journey of the reporting day (and are prompted by the questionnaire to check against a GPS to increase accuracy). This analysis measures Mobility of Care using all three of these metrics as appropriate.

The ODiN includes a large variety of travel modes for respondents to select. This analysis focuses on a few key mode categories that are used for the vast majority of trips, namely: private car (including both when the respondent is the driver and when the respondent is a passenger, but not taxis or ridesharing); train; public transportation (i.e. bus, tram, and metro); bicycle (both conventional and electric); and walking. All other travel modes, which account for a combined 3.11% of trips in the dataset, are considered "other." ODiN respondents divide each trip into separate segments based on the travel mode employed during that segment. For instance, a single trip might be divided into a segment spent cycling to a train station, followed by a segment riding the train, and lastly a segment riding a bus from the train station to the destination. Distance and duration are reported for each segment, so it is possible to measure the total time or distance for each mode by dividing trips into segments. Each trip is also assigned a single value for the "primary" mode used for the trip. For a trip with multiple segments, the primary mode is the mode that was used for the farthest distance (CBS, 2023).

3.3 Analysis steps and regression specification

This paper uses the methodologies described above to identify the trips in the ODiN that were made for Mobility of Care and those that were not. The first stage of the analysis investigates the characteristics of Mobility of Care trips compared to trips for other purposes based on the descriptive statistics from the data. This stage focuses on key differences between care-related and other travel that have been identified in the literature such as differences in gender, age, occupation, and income of travelers and in the distance, duration, and time of day of the trips themselves (Gomez-Varo et al., 2023; Murillo-Munar et al., 2023; Sánchez de Madariaga & Zucchini, 2020; Ravensbergen et al., 2022).

Analysis of Mobility of Care characteristics first examines the differences between trips made for Mobility of Care and trips made for other purposes, to understand the requirements of this type of travel that the transportation system can facilitate. The analysis then turns to characteristics of travelers for Mobility of Care to understand who makes this type of trip, compared to other travel, and how care travel responsibilities vary within the sample population. Given that significant research to date has found that there is a gender gap in travel for care-related tasks (Fong and Shaw, 2024; Gilow, 2020; Maciejewska and Miralles-Guasch, 2019; Montoya-Robledo et al., 2020; Orjuela and Schwanen, 2022; Plyushteva and Schwanen, 2018; 2015Sánchez de Madariaga, 2009; Sersli et al., 2020; Taylor et al.), this section has an emphasis on gender differences in who completes Mobility of Care.

The second stage of the analysis focuses on the relationship between travel mode (e.g. car, bus, bicycle, etc) and Mobility of Care as a trip purpose. First, the use of each mode for Mobility of Care trips is compared to its use for other travel types, using hypothesis tests to identify key differences. Because the mode choices available to individual travelers vary geographically,

this analysis is conducted at the national level and separately for the three largest metropolitan areas in the Netherlands: Amsterdam, Rotterdam/The Hague, and Utrecht.

Subsequently, to analyze the extent to which traveling for Mobility of Care is a predictor of the categorical variable of trip travel mode, a multinomial logistic regression analysis is conducted. Travel mode is a nominal categorical variable without rank; there is no inherent order of modes. Therefore, a multinomial logistic regression calculates the likelihood of each category relative to one base category. In this case, the base travel mode category is private car. Travel mode choice is assumed to follow binary independence, such that the preference of mode A versus mode B does not change based on the availability of mode C. In other words, travelers' decisions to take a certain travel mode instead of others available are assumed to be perfectly rational. This assumption allows a multinomial logistic model to be used. The regression model is:

$$P(m,n)=\beta_C C_n+\beta_k V_n+\varepsilon_n,\ m\in M$$

where P is the probability function of travel mode *m* (within the set of potential travel modes M) for a given trip *n*, C is a dummy variable indicating whether trip *n* is made for Mobility of Care or a non-care related purpose, V is a vector of *k* control variables, and ε is the error term of trip *n*.

For ease of interpretation, the regression coefficients are transformed into odds ratios. For any dependent variable *v*, the corresponding odds ratio for transport mode *m* equals:

$$\frac{\left(\frac{P(m|v=x+1)}{P(base|v=x+1)}\right)}{\left(\frac{P(m|v=x)}{P(base|v=x)}\right)}$$

or the change in the relative probability of travel mode *m* being chosen over the base mode (car) given a unit change in the dependent variable *v*, with all other variables held constant. From the definition of the multinomial logistic regression function, each odds ratio for variable *v* is equal to $e^{\beta v}$, where β_v is the regression coefficient of *v* on transport mode *m*. An odds ratio of 1.00 represents no change in the relative probability of travel mode *m* associated with a change in variable *v*, holding other factors constant. An odds ratio greater than 1.00 indicates that an increase in *v* is associated with an increase in the relative probability of a trip using mode *m*, holding other factors constant, while an odds ratio less than 1.00 indicates that an increase in *v* is associated with a decrease in the relative probability of a trip using *m*, holding other factors constant.

This regression includes both personal and trip-based control variables, chosen to represent the key factors identified as drivers of travel mode choice in the Netherlands by Ton et al. (2019). This study divided factors into individual characteristics (e.g. gender or age), household characteristics (e.g. household income or number of children) and trip characteristics (e.g. travel time or purpose). Control variables from the ODiN were chosen to closely match the variables from the previous study as much as possible. Ton et al. (2019) also included a category of built environment characteristics to measure urbanization level, street type, and infrastructure. There is limited location data in the ODiN to preserve privacy. A variable for the population of the respondent's municipality of residence is included in this analysis under household data as a proxy for urban density, and the regression analysis is run separately on trips made in Amsterdam, Rotterdam/The Hague, and Utrecht to capture travel differences within these major cities. Table 1 below shows sample statistics for these control variables (as well as for the dependent, mode choice variable) from the ODiN survey. The table is divided

between respondent characteristics (which includes household-level variables) and trip characteristics.

Table 1. Sample Description

By Respondent	Number	Percent	By Trips	Number	Percent
Travelers	42,110	-	Trips	144,382	-
Male	21,516	51.1%	Average Trip Distance (km)	11.79	-
Female	20,594	48.9%	Average Trip Duration (min)	27.51	-
Age Class of Respondent			Average Effective Trip Speed (km/h)	21.65	-
18-29	7,844	18.6%	Average Number of Trip Segments	1.09	-
31-64	23,426	55.6%	Average Number of Trips on Response Day	3.77	-
65+	10,840	25.7%	Primary Travel Mode		
Respondent Lives with a Spouse/Partner			Car	64,903	45.0%
No	10,594	25.2%	Train	3,270	2.3%
Yes	31,516	74.8%	Bus/Tram/Metro	3,030	2.1%
Respondent Migration Background			Bicycle	36,956	25.6%
Born in the Netherlands	32,855	78.0%	Walking	31,736	22.0%
Immigrant to the Netherlands	9,255	21.9%	Other	4,487	3.1%
Respondent Primary Occupation Type			Trip Purpose		
Employed Full-Time (≥30 hrs/week)	6,194	14.7%	Commuting	24,114	16.7%
Employed Part-Time (<30 hrs/week)	18,341	43.6%	Other Paid Employment Travel	4,665	3.2%
Unpaid Stay-at-Home Labor	1,409	3.3%	Escorting Persons	11,009	7.6%
Student	3,103	7.4%	Miscellaneous Shopping	39,244	27.1%
Currently Unemployed	508	1.2%	Education/course	3,214	2.2%
Disabled	1,129	2.7%	Visiting	13,896	9.6%
Retired/Pensioner	9,587	22.8%	Leisure (Sports, Entertainment, or Hobbies)	40,668	28.1%
Other	1,839	4.4%	Services/Personal care	5,194	3.6%
Number of Cars in Household			Other	2,378	1.6%
0	6,384	15.2%	Trip Taken During Rush Hour		
1	20,534	48.9%	No	108,104	74.9%
2	11,368	27.1%	Yes	36,278	25.1%
≥3	3,724	8.7%	Season of Trip		
# of Children in Household			Winter	27,591	19.1%
0	30,833	73.2%	Spring	33,606	23.3%
1	4,865	11.6%	Summer	38,006	26.3%
2	4,773	11.3%	Autumn	45,179	31.3%
≥3	1,639	3.8%	Reporting Day is a Holiday		
Standardized Household Income Decile			No	141,996	98.3%
<2	4,658	11.3%	Yes	2,386	1.7%
2 to 4	6,738	16.4%	Reporting Day of the Week		
4 to 6	7,790	19.0%	Monday	20,434	14.2%
6 to 8	9,880	24.0%	Tuesday	21,110	14.6%
>8	12,049	29.3%	Wednesday	21,059	14.6%
Municipality Population			Thursday	21,687	15.0%
<20.000	2,370	5.6%	Friday	22,550	15.6%
20.000 to 49.999	13,139	31.2%	Saturday	21,597	15.0%
50.000 to 99.999	9,763	23.2%	Sunday	15,945	11.0%
100.000 to 249.999	9,399	22.3%			
>250.000	7,439	17.7%			

Source: author

3.4 Expected challenges and limitations

There are several potential limitations to this study. Firstly, respondents to the ODiN survey can only self-identify as either male or female. This limits the analysis to a binary concept of gender without considering other gender identities that are likely relevant to individual care labor and Mobility of Care responsibilities. Furthermore, data are not gathered on respondents' partners or other adults in respondents' households, meaning that analysis of different household structures, such as different divisions of paid employment vs care labor and differences between heterosexual and homosexual couples, is not possible. The Mobility of Care dynamics of non-heterosexual couples has seen little research. One study by Smart et al. (2017) found that homosexual couples tend to divide Mobility of Care more equally than heterosexual couples. These questions cannot be answered using the ODiN. Finally, while the analysis is limited to trips in the ODiN sample taken after nationwide COVID-19 travel restrictions were lifted in January 2022, the continuing prevalence of COVID-19 over the sample year is likely to have altered daily travel patterns. However, the very recent data also present an opportunity to study current travel patterns, as the disruptions of the pandemic to individual mobility mean that data collected prior to 2020 may be less relevant going forward.

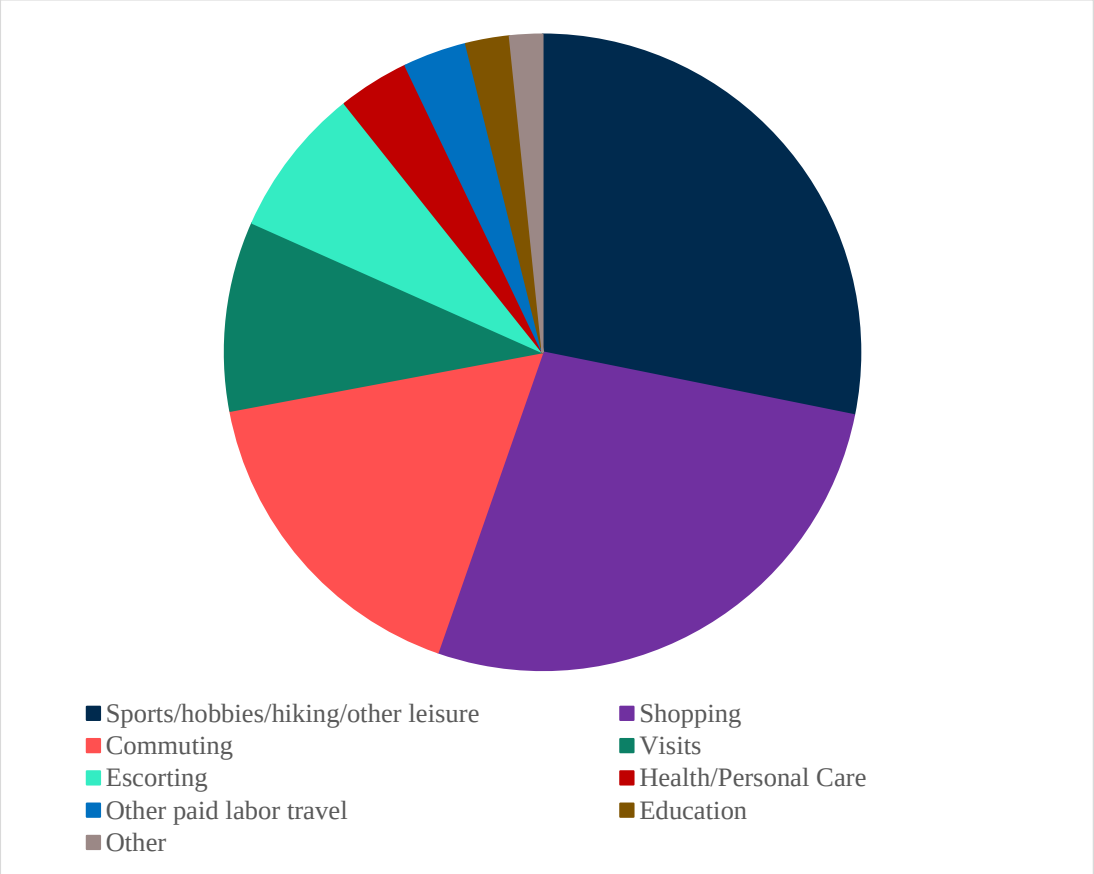
This analysis quantifies the importance of Mobility of Care in relation to other trip purposes in the Netherlands and identify the likelihood of use of different travel modes for Mobility of Care trips compared to other trip types. However, it does not speak to any causal relationships that may underlie the associations found. Furthermore, this paper constitutes only an exploratory analysis that recategorizes trip purpose as reported in the ODiN, which does not itself measure care-related trip purposes. Such recategorization, primarily based on research by Sánchez de Madariaga and Zucchini (2020) in Madrid, Spain, is necessarily imperfect. While the methodology has been translated to foreign contexts by other studies (e.g. Ravensbergen et al., 2022 in Canada), there may be differences between Mobility of Care in Spain and the Netherlands that are not fully captured in the analysis due to the use of this methodology. Accordingly, this analysis compares multiple methodologies for categorizing trip purposes as "care".

4. Results of analysis

Mobility of Care is not a travel purpose that is directly measured by the ODiN survey questionnaire. The travel purposes that it does directly measure are illustrated in Figure 3 below, displayed by proportion of total trips. The largest category of trip purpose is leisure trips (such as sports, hobbies, hiking/walks, and other recreational activities), accounting for 28% of all trips made by adults in the sample. Only slightly less prevalent is shopping, which accounts for 27% of all trips. As a generic category, shopping can include various types of trips, some of which may constitute care while others are more recreational. Taken together, leisure and shopping make up over half of all trips.

Commuting is the third most prevalent trip purpose with 17% of trips, and when including other types of business and professional travel, paid employment accounts for roughly 20% of travel. After paid employment the largest purpose categories are "visiting" (10%, and another ambiguously defined purpose), escorting (8%), health and personal care (4%), and education (2%). Other trip purposes round out the final 1%.

Figure 3. ODiN Trip Purpose Categories by Frequency (Without Mobility of Care)

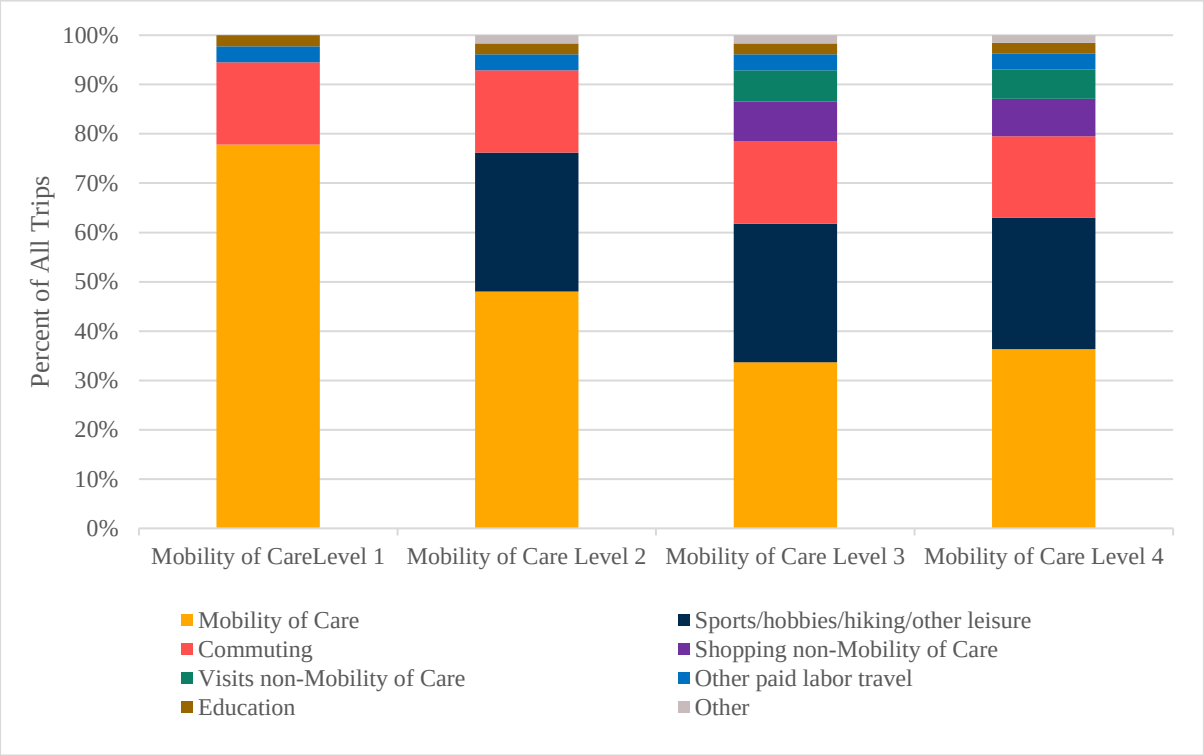


Source: author

The overall picture of travel purposes changes dramatically when Mobility of Care is introduced as an analytical category, as shown in Figure 4. All four calculation methodologies show Mobility of Care to be the largest single travel purpose among respondents to the ODiN survey in terms of the number of trips. Travel for care represents 78% of trips when using the broadest definition of care. Even when using narrower methodologies that exclude recreational travel, Mobility of Care represents between 34% and 48% of trips. Sports, leisure, and hobbies are the second largest travel purpose when they are not considered part of Mobility of Care,

followed by commuting to work at third. Travel for paid employment, including both commuting and other work-related travel, still accounts for roughly 20% of trips.

Figure 4. Percent of Trips Taken for Each Purpose (With Mobility of Care)



Source: author

The importance of Mobility of Care as a travel purpose is also observed when measuring based on the proportion of time and distance travelled. Table 2 below shows the trips for each major purpose in terms of proportion of trips, travel time, and distance. Mobility of Care Level 1, the broadest category that includes all trip purposes except education and employment, accounts for close to three quarters of trips, travel time, and distance covered. However, this methodology is so broad as to make comparisons with other purposes difficult. Excluding Level 1, Mobility of Care represents between 25.2% and 37.6% of the total time respondents spent traveling during the day, and between 26.2% and 39.3% of the total distance they covered. This is above travel for paid employment, which accounts for 23.3% of total time and 25.1% of total distance, and comparable to travel for leisure activities, which accounts for 34.7% of total time and 30.9% of total distance.

Table 2. Proportion of Travel by Purpose

Trip Purpose		Percent of Trips Taken	Percent of Total Travel Time	Percent of Total Travel Distance
Mobility of Care Level	**1**	77.8%	74.0%	72.1%
	2	48.0%	37.6%	39.3%
	3	33.7%	25.2%	26.2%
	4	36.4%	28.3%	29.3%
Work Travel		19.9%	23.3%	25.1%
Leisure Travel		28.2%	34.7%	30.9%

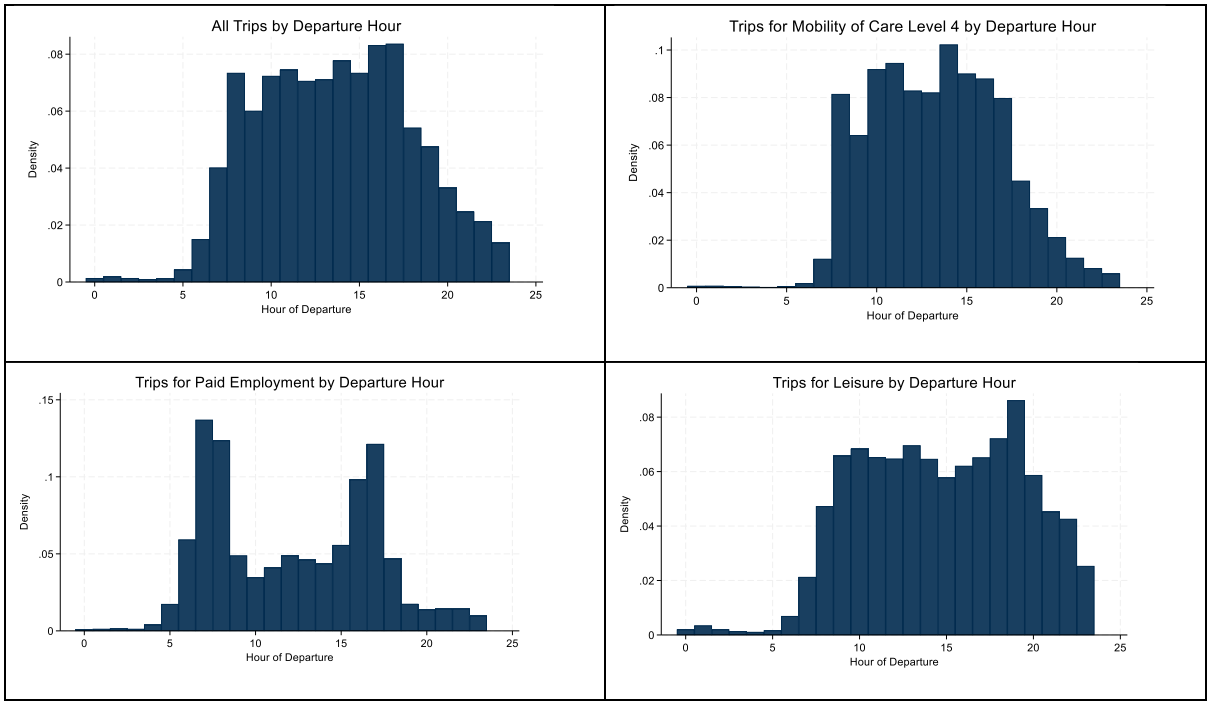
Source: author

In overall terms, respondents report spending between 19.3 and 29.5 minutes per day and covering between 9.0 and 14.8 km on care-related travel, on average (excluding Level 1, the broadest category). This is compared to an average of 20.2 minutes and 13.3 km per day on travel related to paid employment, and 40.1 minutes and 9.9 km on travel for leisure activities. The total travel time and distance for Mobility of Care on average is comparable to total travel for paid employment, and comparable to leisure in terms of distance covered. Overall, Mobility of Care represent among the largest categories of daily travel among residents of the Netherlands.

4.1 Characteristics of Mobility of Care trips

Travel for Mobility of Care generally takes place at different times of day relative to other travel purposes. While over two fifths (42.9%) of trips for paid employment are made during rush hour (having departure times between 07:00-09:00 and 17:00-19:00), only around a fifth Mobility of Care trips are made at rush hour. Similarly, about a fifth of leisure trips are made at rush hour. As shown in the histograms (Figure 5) below, Mobility of Care travel is distributed roughly equally throughout the day between 07:00 and 18:00, while work trips are more likely to take place around rush hour and leisure trips are skewed toward the evening.

Figure 5. Daily Trips by Departure Hour, Divided by Trip Purpose



Source: author

On average, trips made for Mobility of Care also take significantly less time than trips made for paid employment or for leisure. Depending on the calculation methodology, care trips last between 7.8 minutes (Mobility of Care Level 3) and 9.6 minutes (Level 1) on average, compared to 10.2 minutes for leisure trips and 19.5 minutes for work trips. Care trips are also shorter in terms of distance travelled, averaging between 16.7 km (Level 3) and 26.7 km (Level 1). This is compared to an average of 41.4 km for leisure trips and 29.5 km for work trips. These comparisons are summarized in Table 3 below.

Most trips in the ODiN sample, roughly 95%, are made with only one mode segment (i.e. the traveler did not switch modes at any point). When comparing Mobility of Care to paid employment and leisure as trip purposes, the average number of segments per trip is just above one for all categories. However, trips for all levels of Mobility of Care on average have 0.09-0.11 fewer segments than work trips and 0.03-0.05 fewer segments than leisure trips, and these differences are significant at 1%. Put another way, while all trips are most likely to be made by only a single travel mode, trips made for Mobility of Care are less likely to transfer between modes than trips for paid employment or leisure.

Finally, among the most significant differences between Mobility of Care and other trip purposes is the likelihood of being part of a trip chain. A trip chain occurs when multiple trips are made sequentially during the same outing. For this analysis, a trip chain is defined as a sequence of trips where the end of one trip is no more than one hour before the start of the following trip and the respondent does not return home between them. For example, a trip chain could entail running multiple errands back-to-back, or dropping-off children at school and then continuing on to work. Overall, 44% of trips in the ODiN sample were made as part of trip chains.

Trips for Mobility of Care, however, are far more likely than other trip types to be part of trip chains. When excluding Level 1, the broadest calculation methodology, between 72.6% and 79.7% of care trips are made as part of trip chains, a rate that is between 50- and 54-percentage points higher than non-care related trips (all significant at 1%). By comparison, trips made for paid employment are part of trip chains only 15.5% of the time, and leisure trips only 20.9% of the time. Trip chaining has important implications for travel mode choice. Making multiple trips in close succession can make public transit less convenient as it increases the time that must be spent waiting at a stop, and chaining trips travelers are more likely to be carrying extra goods or accompanied by other persons who will be picked-up or dropped-off along the way.

Table 3. Trip Characteristics by Purpose

Trip Purpose		Average Time (min)	Average Distance (km)	Average Speed (km/h)	Proportion Begun During Rush Hour	Proportion Made as Part of Trip Chains	Average # of Segments
Mobility of Care	**1**	9.6	26.7	18.9	20.4%	52.6%	1.06
	2	9.0	17.9	20.6	20.1%	72.6%	1.05
	3	7.7	16.5	19.9	21.9%	79.7%	1.04
	4	8.0	17.9	20.0	21.8%	76.2%	1.04
Work		19.5	29.5	32.1	42.9%	15.5%	1.15
Leisure		10.2	41.4	15.6	20.6%	20.9%	1.09

Source: author

As shown in Table 3, characteristics of Mobility of Care trips are generally similar for Levels 2-4, while Mobility of Care 1 is extremely broad and less relevant as a category of travel purpose. Therefore, the remainder of this paper focuses on Mobility of Care Level 4, which includes a proportion of shopping and visiting trips, all escorting and health trips, as well as all trips accompanied by a child under the age of six.

4.2 Characteristics of Mobility of Care travelers

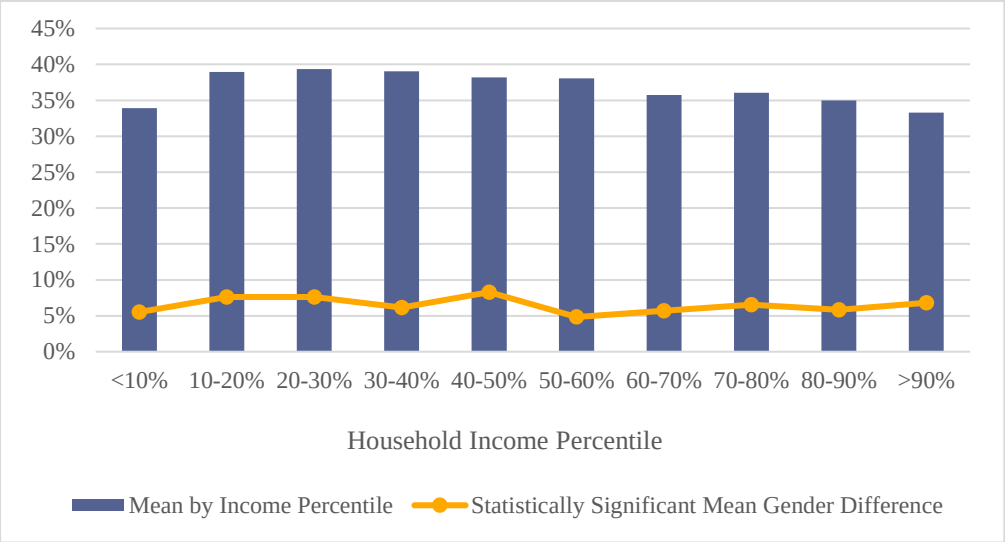
Mobility of Care in the Netherlands is performed more by women than by men. Women complete 55% of the care trips in the sample compared to 45% by men, even though only 49% of respondents were women. By comparison, women and men complete approximately the same number of leisure trips, and men complete 58.5% of trips for paid employment.

There is also a difference in proportion of each respondent's trips made for Mobility of Care. Women in the sample devote 39.5% of their trips to Mobility of Care on average, compared to only between 33.1%. Therefore, there is a gender gap of 6.4 percentage points, significant at 1%. By contrast, the difference for proportion of trips made for leisure is less than one percentage point, and men devote 8.3 percentage point more trips to paid employment than do women (significant at 1%).

On average, women in the survey report spending more time than men travelling for care each day and travelling farther for care. The average woman in the sample spends 24.4 minutes each day traveling for Mobility of Care while the average man spends 20.3 minutes, 4.1 minutes or 17% less (significant at 1%). By comparison, the average woman spends 15.8 minutes traveling for paid employment and the average man spends 24.4 minutes, 8.6 minutes or 54% more (significant at 1%), and there was no significant difference between time spent traveling for leisure activities. The difference in distance traveled for Mobility of Care is less pronounced but still significant. Women report traveling 0.6 km (or 6%) farther each day for care travel than do men, while men travel farther than women for both paid employment (8.5 km or 95% farther, significant at 1%) and leisure (1.7 km or 19% farther, significant at 1%). These considerable differences show that Mobility of Care is disproportionately a burden for women in the Netherlands rather than for men.

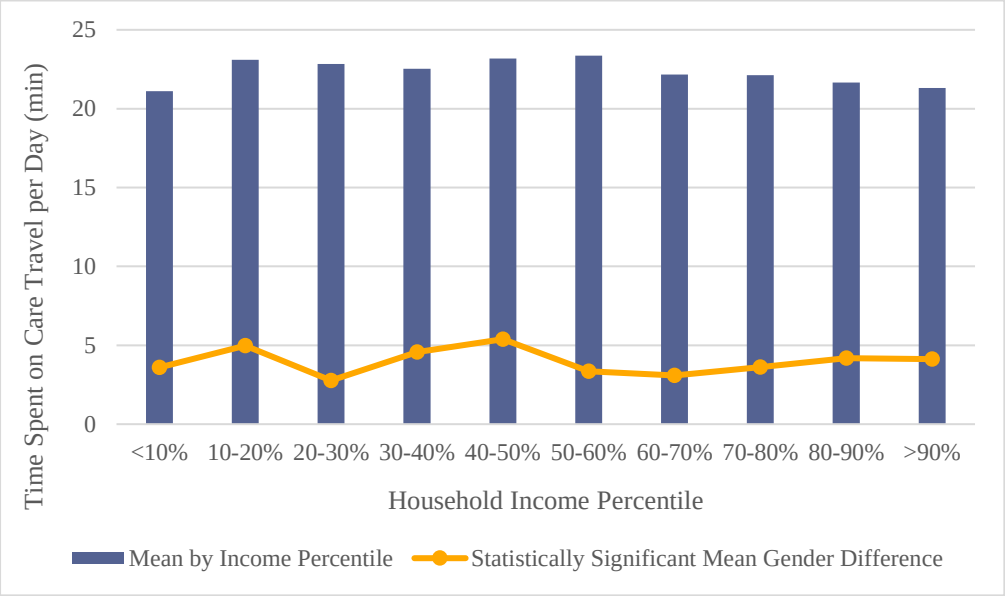
Mobility of Care does not vary significantly as household income increases, as shown in Figures 6 and 7. Households at all income percentiles dedicate between 33% and 39% of daily trips to care and spent between 21 and 23 minutes per day on care travel, on average. Women devote a larger proportion of their trips to Mobility of Care than do men at all income levels (all differences significant at 1%). Ravensbergen et al (2022) found that gender differences in the proportion of trips made for Mobility of Care decreased as household income increased in Montreal. However, in the Netherlands, the gap in the proportion of trips made for Mobility of Care by women and men is relatively constant between roughly 5-8% for households at all income levels, as shown in Figure 6. When considering the gender gap in terms of time spent traveling for care, there is similarly no clear trend, as shown in Figure 7. Women of all income levels spend roughly 3-5 more minutes each day traveling for care than do men (all significant at 1%). Finally, there are not significant differences in the distance traveled for Mobility of Care by men and women at any income level.

Figure 6. Proportion of Care Trips by Income Percentile



Source: author

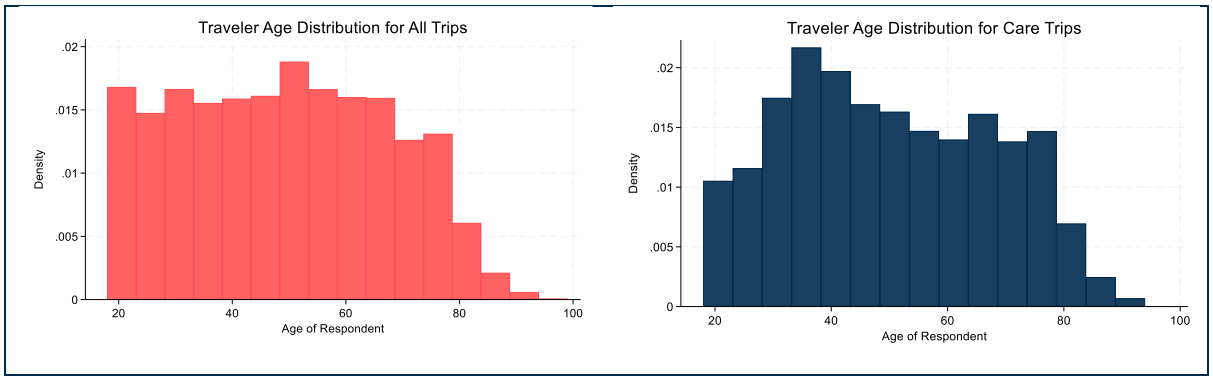
Figure 7. Daily Travel Time for Care by Income Percentile



Source: author

Mobility of Care varies with traveler age, as shown in the histograms in Figure 8. Compared to the age distribution of all travelers, the age distribution of travelers for Mobility of Care trips shows a spike in care trips made by travelers between 30-45 years-old, the age when respondents are most likely to have young children. Mobility of Care trips are relatively less likely to be made by travelers under 30 than all trip purposes.

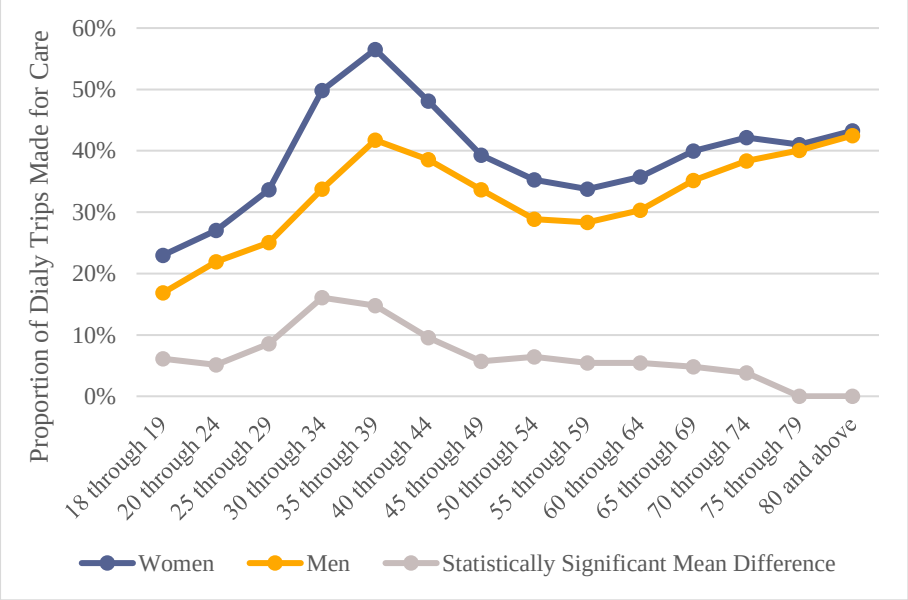
Figure 8. Traveler Age Histograms



Source: author

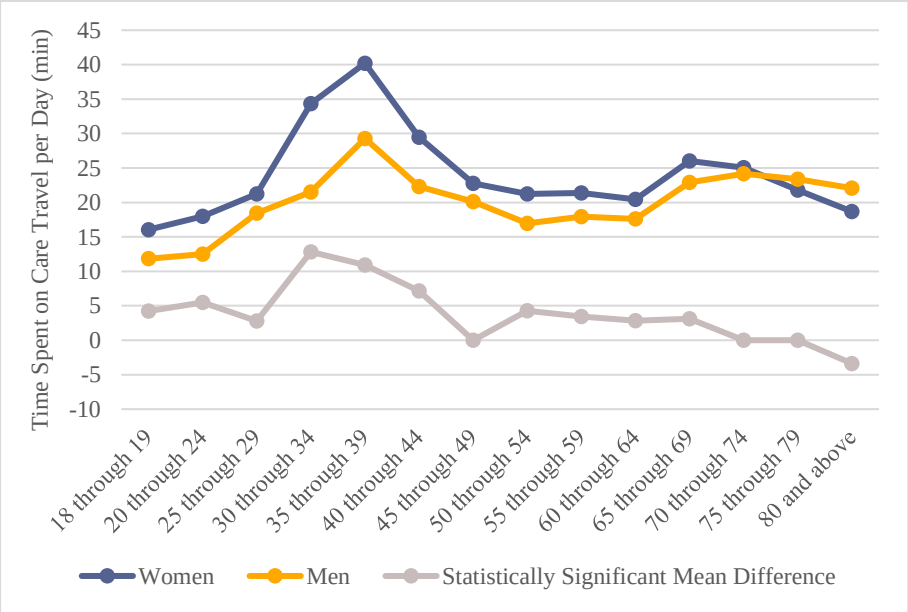
The gender differences in Mobility of Care responsibilities also vary with age. The spike in Mobility of Care travel by 30–45-year-olds is seen in both men and women. Furthermore, it can be seen when considering proportion of trips (see Figure 9) and time spent (see Figure 10). The difference in Mobility of Care also increases for this period by both metrics, indicating that these respondents, the most likely to live with young children, also divide Mobility of Care responsibilities less equally. However, gender differences in distance travelled for care are negligible for most age categories except for 20-24 and 30-34 (when women travel farther) and above 75 (when men travel farther).

Figure 9. Gender Difference in Mobility of Care as Proportion of Trips Taken by Age



Source: author

Figure 10. Gender Difference in Mobility of Care Travel Time by Age

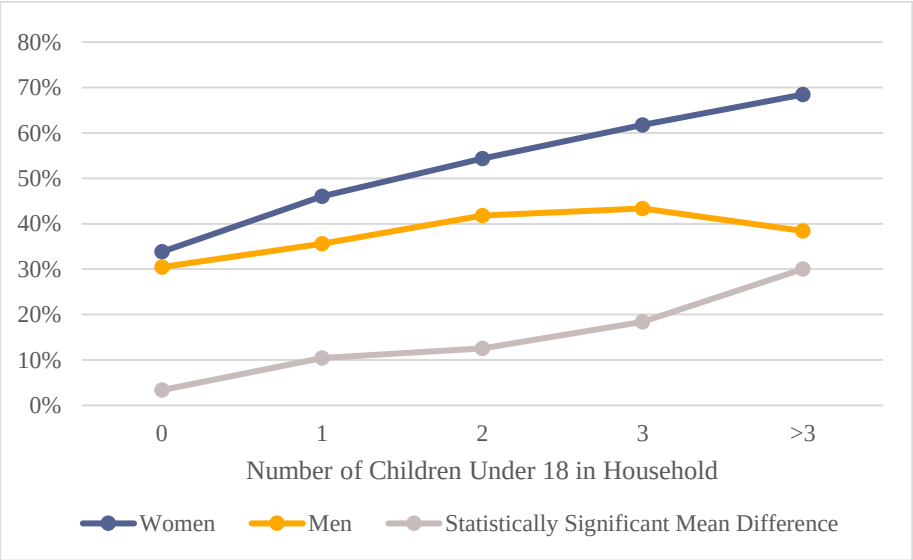


Source: author

Unsurprisingly, Mobility of Care responsibilities are correlated with the number of children in the household. Respondents who live with at least one child under 18 report devoting an average of 40.2% of their trips to Mobility of Care, a 6.8-percentage point higher proportion than respondents who do not live with any children (significant at 1%). Similarly, respondents living with at least one child spend on average 32.6 minutes per day traveling for care (7.0 minutes more than childless respondents, significant at 1%) and cover on average 13.9 km per day (2.4 km more than childless respondents, also significant at 1%). Respondents with two or more children spend on average 50.1% of their trips, 40.1 daily minutes, and 15.2 daily km traveling for care. Respondents with at least one child under six-years-old report, unsurprisingly, an even higher Mobility of Care burden, spending on average 63.6% of their trips, 54.4 daily minutes, and 20.6 km per day on care travel.

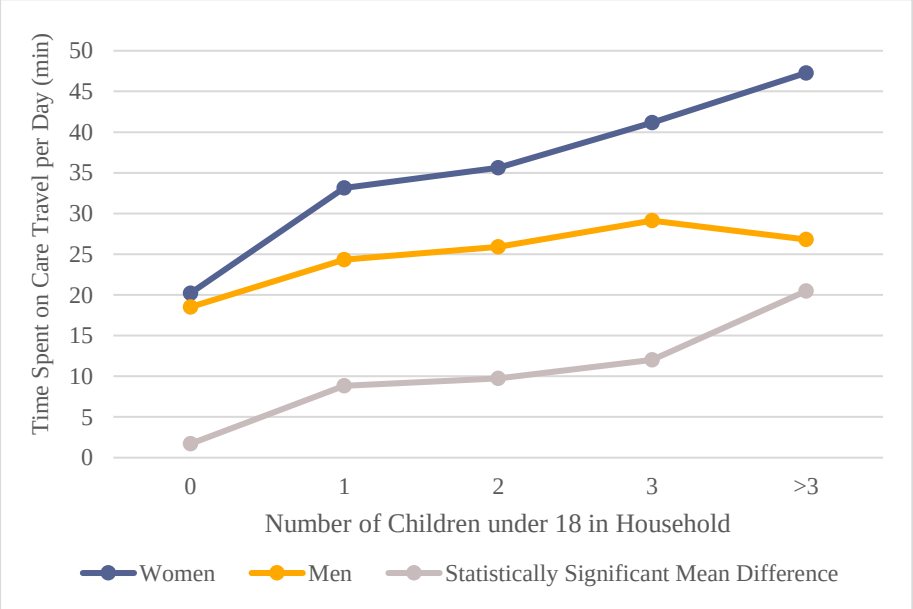
Gender differences in Mobility of Care responsibilities are greater for respondents with children and increase the more children are present in the household, as illustrated in Figures 11 and 12. Women who do not live with children report devoting 2.8 percentage points more trips to Mobility of Care compared to men who do not live with children. However, as shown in Figure 11, among respondents living with one child, women spend 10.1 percentage points more trips on Mobility of Care than men. This difference increases with each additional child, up to a 29.4 percentage point difference for respondents living with more than three children. As shown in Figure 12, the same pattern is observed in terms of time spend traveling for Mobility of Care; while the difference between women and men with no children is less than two minutes per day, it rises to more than 20 minutes per day for respondent with more than three children. While the biggest increase in the gender difference is associated with a change from no children to one child, Mobility of Care becomes increasingly unequally gender-divided in households with more children.

Figure 11. Gender Difference in Mobility of Care as Proportion of Daily Trips by Number of Children



Source: author

Figure 12. Gender Difference in Mobility of Care Travel Time by Number of Children



Source: author

Living with a spouse or partner also associated with a higher Mobility of Care burden. Respondents who live with a spouse or partner report spending an additional 5.2 minutes and 2.9 km on care travel per day (significant at 1%). This likely captures part of the effect of having children, as respondents living with a spouse in the survey are considerably more likely to have children than unpartnered respondents. However, when looking only at respondents with no children in their household, living with a spouse is still associated with a 3.5-minute increase in daily time spend traveling for care and a 2.2 km increase in daily distance travelled for care (both significant at 1%). It seems that just living with a spouse or partner slightly increases care travel responsibilities. Interestingly, in this case, gender is not a significant factor. The increase in Mobility of Care for partnered vs unpartnered respondents is not significantly different between men and women.

Gender differences in the sample may be partially related to differences in employment rate, as men in the sample are slightly more likely to work for pay at least part-time than women (63.1% of men vs 59.6% of women, significant at 1%) and Mobility of Care responsibilities vary by employment status, as shown in Figures 15 and 16. Students and full-time workers report dedicating the lowest proportion of their trips and the least daily travel time to Mobility of Care. The greatest Mobility of Care responsibilities are among respondents who report their primary occupation as stay-at-home caregivers. They spend over 30 minutes per day traveling for care, 9.8 minutes more than the mean for all other respondents, and nearly half of their trips are made for care, 19 percentage points more than all other respondents (both are significant at 1%). Additionally, retirees and respondents who receive disability aid report spending considerable time and proportion of trips on Mobility of Care, more than full- or part-time employed respondents. This may be evidence of intergenerational or inter-household Mobility of Care networks through which the elderly or other who do not work provide supplemental care labor for family and friends who may have young children or otherwise need extra help.

However, as shown in Figures 13 and 14, gender differences in Mobility of Care (shown as mean for women less mean for men) persist when controlling for employment. Full-time employed women travel an average of 4.8 minutes or 25% more than full-time employed men (significant at 1%). This difference is also observed in distance travelled for Mobility of Care (full-time employed women travel 0.7 km farther per day, significant at 10%) and for proportion of trips made for care (4.2 percentage points more, significant at 1%). In essence, even when women are working for pay outside of the household, they are still responsible for a higher proportion of Mobility of Care relative to men. This pattern is even more pronounced between men and women who are employed part-time. Women employed part-time travel on average 7.2 min (or 39%) more for care each day than men who are employed part-time, as well as traveling 2.8 km (or 35%) farther and dedicating 10.4 percentage points more trips to care (all significant at 1%).

Gender differences are not quite as large between men and women who report their primary occupation as stay-at-home caregiver. There is not a statistically significant difference between the average daily travel time or distance for Mobility of Care of stay-at-home men compared to stay-at-home women. However, stay-at-home men devote smaller proportion of their total trips to care relative to stay-at-home women, 39.5% compared to 48.4%, an 8.9-percentage point gap (significant at 1%). It seems that, in general, men who are stay-at-home carers take on similar Mobility of Care responsibilities to stay-at-home women but are also more likely to travel for other activities than stay-at-home women.

Compared to employed and stay-at-home respondents, there is little difference in time spent, distance traveled, or proportion of trips for Mobility of Care between male and female respondents who are retired or who receive disability benefits. As previously noted, gender differences in Mobility of Care appear to be most prevalent among middle-aged respondents. Retirees and disabled respondents, who have a mean age of 71, appear to split care-related travel more equally by comparison.

Finally, students report the greatest gender gap in Mobility of Care, despite also reporting the least care travel responsibilities. Female students spend on average 12.0 more minutes each day traveling for care than male students (a 51% difference, significant at 1%) and dedicate 7.6 percentage points more trips to care than male students (a 48% difference, also significant at 1%) Approximately 63% of students report living with at least one child in the household and male students are 3.9% more likely to live with children than female students (significant at 1%). Therefore, it seems that female students have significantly more care travel responsibilities than male students not because they have more dependents to care for, but

because they assume more of the Mobility of Care tasks for those dependents than their male counterparts.

Figure 13. Mobility of Care Travel Time by Primary Occupation

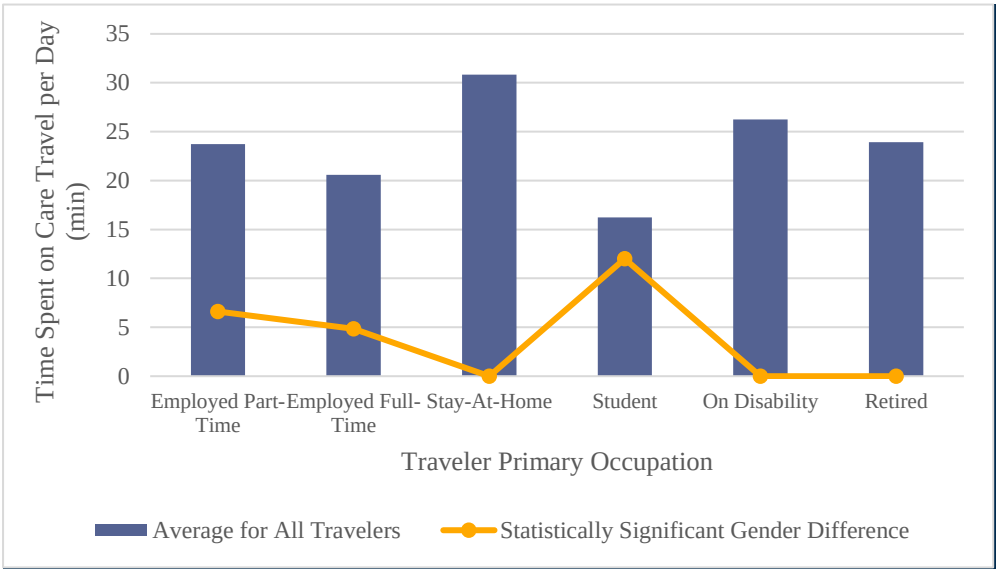
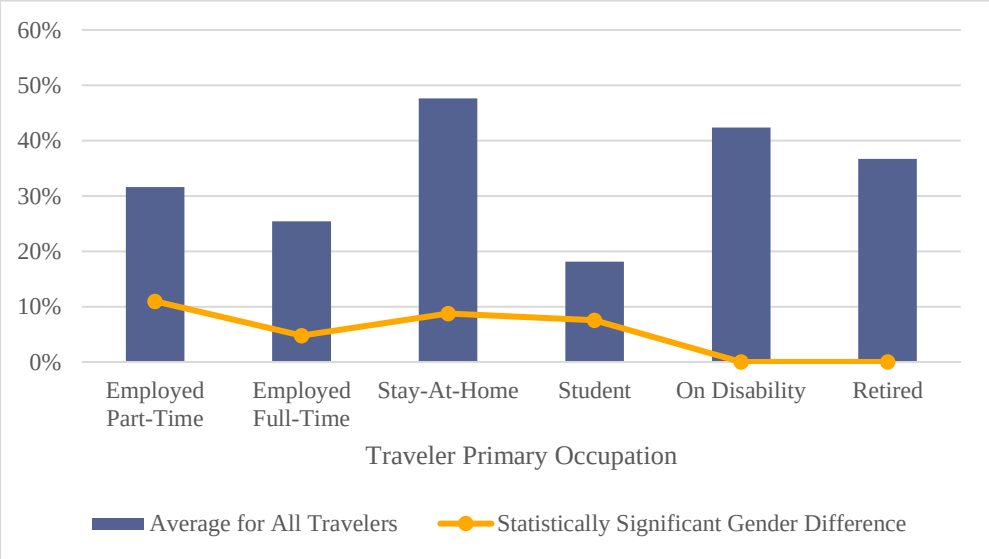


Figure 14. Mobility of Care as Proportion of Total Trips by Primary Occupation



It should be noted that these are not intra-household comparisons, as only one member of a given household can be sampled for the ODiN survey. These statistics represent only generalized averages for the entire population, rather than comparisons of different household structures.

4.3 Travel modes and Mobility of Care

Mobility of Care trips tend to use different travel modes compared to other travel purposes, as illustrated by Figures 15 and 16 below. By far the largest proportion of Mobility of Care trips, 51%, are either made using a personal car, which is 9.5 percentage points higher than the rate of car use for trips of all other purposes. Bicycling is the second most common mode for care

trips, with slightly over a quarter of the total. Conventional bicycles account for 17.3% of care trips, nearly double the 8.8% of care trips made on electric bicycles. Both types of bicycles are used for a greater percentage of Mobility of Care trips than other trip types (differences significant at 1%).

Besides car and bicycle, all other travel modes tested are used for a smaller proportion of Mobility of Care trips relative to all other trip types (differences are significant at 1%). The largest such disparity is with train, used for less than 1% of care trips but 3.1% of trips for other purposes. This is understandable considering that Mobility of Care trips, as shown previously, tend to be quicker and shorter than other trip types and therefore less likely to require the distance covered by a train journey. Walking is used for 19.0% of care trips but 23.7% of all other trip types, making it the third most used mode for both categories behind car and bicycle. Metro, tram, and bus are used for only a combined 2.4% of non-care related trips, but less frequently still for Mobility of Care trips at only 1.5%, indicating that they may be less convenient for care-related travel.

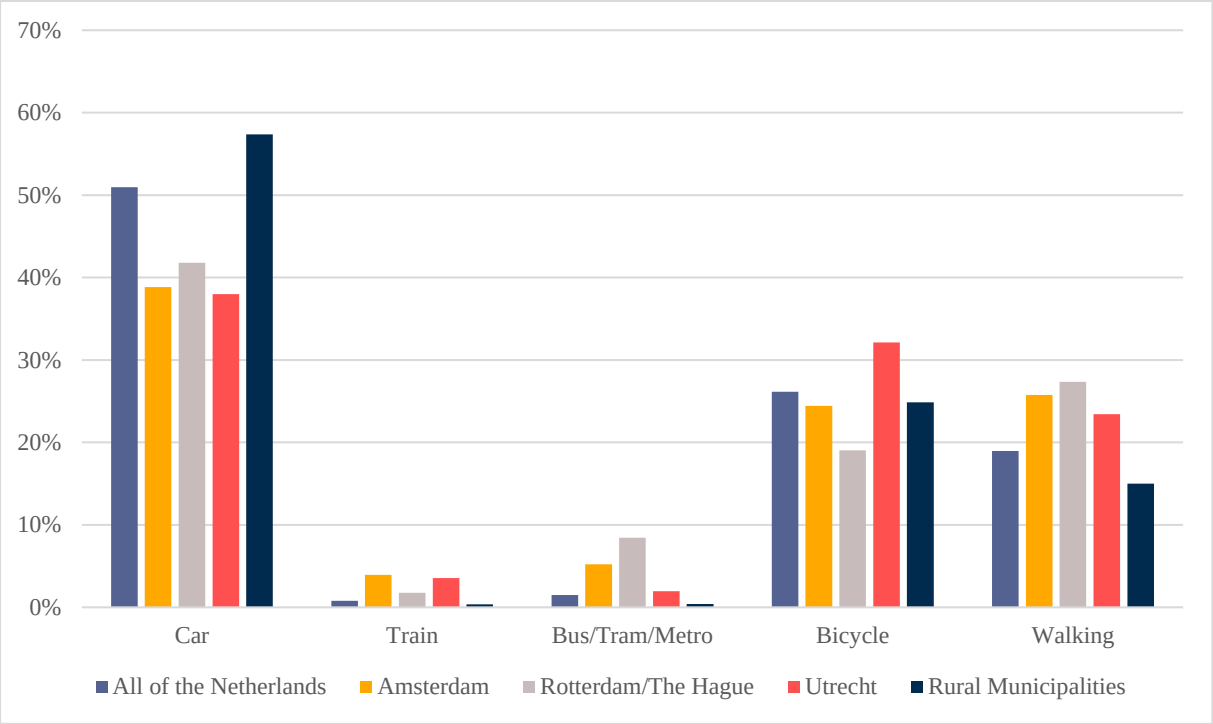
Considering only trips that originate or terminate within the city limits of the Netherlands' three largest cities, Amsterdam, Rotterdam/The Hague, and Utrecht, shows a somewhat different picture of the travel modes used for Mobility of Care. Within these cities, the proportion of Mobility of Care trips made by car decreases from roughly half (for the entire country) to between 38% and 42%, reflecting the increased availability of alternative transport modes in urban areas. In all three cities the proportion of non-care trips made by car is lower still. Amsterdam and Rotterdam/The Hague show a higher (but still small) proportion of care trips using bus, tram, or metro relative to the national average, while in Utrecht public transport is not significantly more common than the national average. This same pattern is seen for non-care-related trips, although the increase in Amsterdam and Rotterdam/The Hague relative to the national average is not as large as that seen with Mobility of Care.

Bicycling is also different across these cities. In Utrecht, nearly a third of Mobility of Care trips are made on a bicycle (either electric or conventional), above the national average of 25%, while Amsterdam and Rotterdam/The Hague both show lower cycling rates for care trips (24% and 19%, respectively). A similar pattern is present in the proportion of trips of any purpose made on bicycle, with below average cycling rates in Amsterdam and Rotterdam/The Hague and slightly above average rates in Utrecht.

In all three cities, a slightly higher proportion of Mobility of Care trips are made on foot compared to the national average. By contrast, in all three cities a slightly lower proportion of non-care related trips are made on foot.

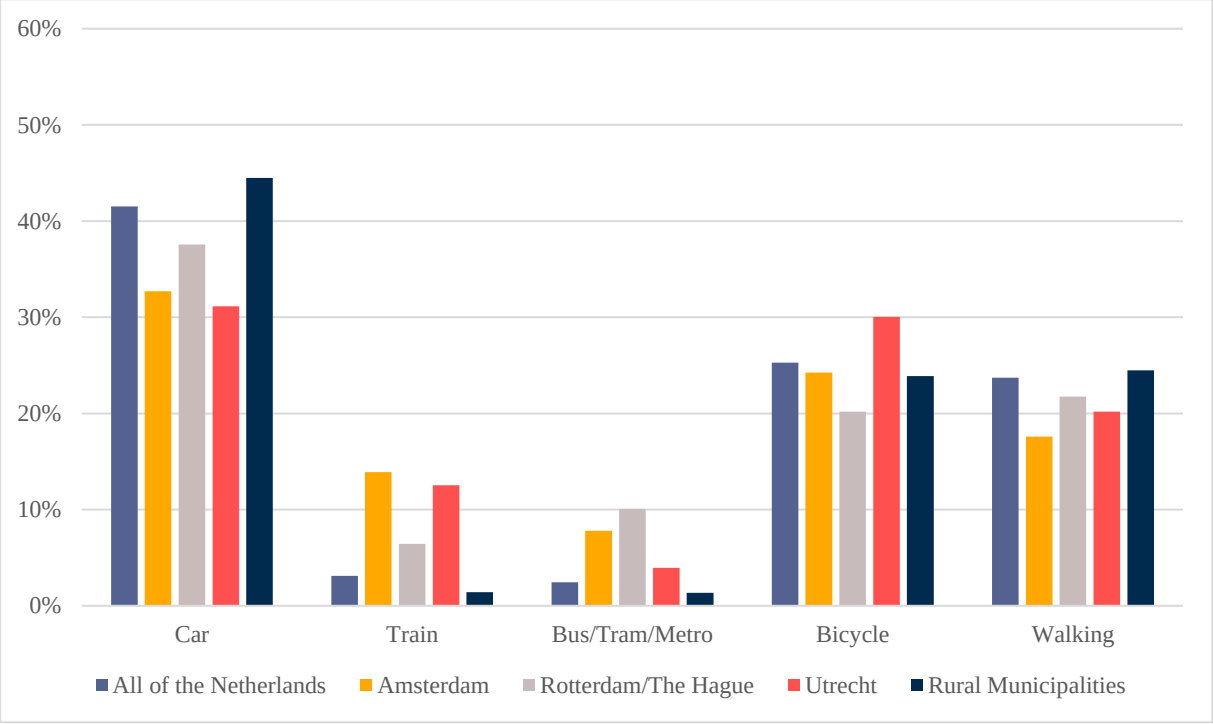
As a comparison with these large urban centers, residents of rural municipalities with 20.000 inhabitants or fewer report driving for 57% of Mobility of Care trips (above the national average of 51%) and 45% of non-care related trips (above the national average of 42%). Respondents in small municipalities use train and other public transit at lower rates than the national average for all types of trips, which is unsurprising given that public transport network coverage is generally lowest in rural areas. They further report cycling at rates comparable to the nation overall for both care trips and other trip types. However, while they walk for non-care related trips at a similar rate to the entire country, they are less likely walk for Mobility of Care than the country overall. Overall, these respondents drive for between 2-3 times as many trips as they either walked or cycled and report negligible use of train and other public transit.

Figure 15. Proportion of Mobility of Care Trips Made by Each Travel Mode



Source: author

Figure 16. Proportion of Non-Care Related Trips Made by Each Travel Mode



Source: author

To analyze the extent to which traveling for Mobility of Care is a predictor of the categorical variable of trip transport mode, a multinomial logistic regression analysis was conducted. The regression results are illustrated in Table 4.

The odds ratios for Mobility of Care on all four modes are below 1.0, indicating a lower likelihood of being chosen than car than trips of any other purpose, holding other factors constant. However, the odds ratio for bus, tram, or metro is not statistically significant, indicating that there is no difference in the chance of traveling by bus, tram, or metro instead of by car between Mobility of Care trips and any other trip purpose. This indicates that trip purpose is not a predictor of bus, tram, or metro use.

Care trips are considerably less likely to use the train than non-care related trips. Respondents are 44% less likely to take the train instead of driving for Mobility of care than for non-care related trips, holding other factors constant. This likely reflects the fact that the train network serves intercity journeys that are less important for Mobility of Care, which tends to take place within one's city or neighborhood.

Respondents overall are 43% less likely to choose a conventional bicycle over a car for Mobility of Care than they are for trips of any other purpose, holding other factors constant. However, the equivalent likelihood of choosing an electric bicycle over a car is only 33% lower for Mobility of Care than for other purposes, holding other factors constant, indicating that electric bicycles partly offset the disadvantage of cycling for care travel. The chances of choosing to travel on foot instead of driving for Mobility of Care are 60% lower than for trips of other purposes.

Table 4. Odds Ratios of Mobility of Care Trips Being Taken by Each Mode Relative to Car

	Train	Bus/ Tram/ Metro	Bicycle	Electric Bicycle	Walking
Mobility of Care	0.557***	0.914	0.569***	0.671***	0.400***
Respondent Characteristics					
Respondent is Female	1.097**	1.181***	0.737***	1.181***	0.735***
Respondent Age	0.963***	0.973***	0.995***	1.017***	0.999
Respondent Lives with a Spouse	1.476***	1.109**	1.231***	1.544***	1.185***
Respondent is an Immigrant	1.199***	2.277***	0.668***	0.497***	0.654***
Respondent Occupation Status (Base = Employed Full-Time)					
Employed Part-Time	1.284***	1.401***	1.312***	1.472***	0.961
Stay-At-Home	0.341***	0.844	0.921	1.319***	0.995
Student	4.701***	4.371***	2.719***	1.258***	1.366***
Currently Unemployed	1.183	0.936	0.894	0.812	0.707***
On Disability	0.547***	0.858	0.541***	1.318***	0.841**
Retired	0.492***	1.120	0.744***	1.216***	0.662***
Household Characteristics					
# of Cars in Household	0.314***	0.437***	0.524***	0.672***	0.666***
# of Children in Household	0.860***	0.864***	1.049***	1.051***	0.990
Household Income Decile (1-10)	1.038***	0.985*	1.061***	1.035***	1.046***
Municipality Population > 100.000	1.567***	1.675***	1.369***	0.843***	1.145***
Trip Characteristics					
Log of Trip Distance	8.397***	3.169***	0.783***	1.037***	0.691***
Log of Trip Effective Speed	0.109***	0.0542***	0.0582***	0.0907***	0.00224***
Part of a Trip Chain	0.463***	0.546***	0.628***	0.708***	0.550***
Trip Taken at Rush Hour	1.468***	1.273***	1.119***	1.082***	1.248***
Season (Base = Winter)					
Spring	1.082	1.051	1.280***	1.376***	1.006
Summer	0.984	0.957	1.459***	1.732***	1.032
Autumn	1.158**	1.069	0.962	1.175***	0.834***
Day of the Week (Base = Monday)					
Tuesday	0.998	1.054	0.951	1.009	0.865***
Wednesday	0.756***	0.984	0.967	1.012	0.916*
Thursday	0.938	0.924	0.837***	0.846***	0.742***
Friday	0.936	0.826**	0.849***	0.873***	0.760***
Saturday	0.457***	0.618***	0.679***	0.702***	0.621***
Sunday	0.264***	0.391***	0.645***	0.646***	0.815***

McFadden's Pseudo R^2=0.4171

*** p<0.01, ** p<0.05, * p<0.1

Source: author

To further investigate the relationship of mode choice and care travel in a primarily urban context, this same regression model was run again on only those trips originating or terminating within the city limits of Amsterdam, Rotterdam/The Hague, or Utrecht. The results are reported in Table 5.

The general pattern of travel modes for Mobility of Care trips measured across the entire country holds for these three major urban areas, with some differences. In Amsterdam and Utrecht, the odds ratio of traveling for care using bus, tram, or metro instead of a car is lower than in the entire country. However, the equivalent odds ratio in Rotterdam/The Hague is not statistically different from one, like the country as a whole, despite having a generally similar

public transit network relative to Amsterdam, with a combination of bus, tram, and metro routes.

All three cities have slightly lower odds ratios for conventional bicycling compared to the entire country, with Amsterdam being just seven percentage points lower but Rotterdam/The Hague and Utrecht being 12 and 13 percentage points lower, respectively. This means that, compared to non-care related travel, Mobility of Care trips in these cities are even less likely to be made by bicycle than in the entire country. For electric bicycles, the odds ratio for Rotterdam/The Hague is only slightly below the entire country, while Amsterdam and Utrecht are considerably lower. While Amsterdam has an odds ratio for walking comparable to the country as a whole, Rotterdam/The Hague's odds ratio is slightly lower and Utrecht's is substantially lower, indicating that Mobility of Care is less strongly associated with walking in Utrecht relative to other purposes.

Table 5. Odds Ratio (OR) of taking each mode relative to car for Mobility of Care, by Location

Trips Originating or Ending in:	Train	Bus/ Tram/ Metro	Bicycle	Electric Bicycle	Walking
All of the Netherlands	0.557***	0.914	0.569***	0.671***	0.400***
Amsterdam	0.430***	0.518***	0.506***	0.392***	0.400***
Rotterdam/The Hague	0.719	1.076	0.448***	0.657**	0.350***
Utrecht	0.439***	0.578**	0.432***	0.481***	0.252***

*** p<0.01, ** p<0.05, * p<0.1
Source: author

Overall, there are significant differences in the relative likelihoods of Mobility of Care trips selecting each travel purpose between these three major cities and the entire country, despite these cities being relatively similar demographically and geographically. Measuring Mobility of Care in more targeted travel surveys in these cities going forward could give planners better information about the specific needs of care travel in each city to best facilitate this type of travel.

5. Discussion

5.1 Mobility of Care Characteristics

Mobility of Care is the largest single travel purpose observed in adults' daily travel in the Netherlands by proportion of trips taken, and the second largest travel purpose measured by trip duration and distance covered. And yet, it is not being systematically measured by the ODiN or any other regular travel surveys, which makes it difficult to plan for and facilitate this type of travel. Importantly, Mobility of Care trips also look very different from trips for other purposes such as commuting, leisure, or education. They take place throughout the day rather than clustering at certain hours. They are generally short and quick, but much more likely than other trip types to be chained together. These factors make Mobility of Care travel more difficult than other trip types. Travelers making multiple short trips are inconvenienced more compared to travelers making one long trip when they face travel delays such as waiting for a bus. Because Mobility of Care travel needs occur throughout the day, wait times may be longer as public transit schedules often prioritize on-peak rush hour service. These travel needs are also more likely to conflict with paid work schedules. Finally, the ability to chain care trips together depends on having convenient access to all of the destinations without going far out of one's way. This isn't guaranteed, and may lead households to make difficult trade-offs, as well as increasing cost of living in areas with lots of services.

Given Mobility of Care is shown to differ from other types of travel in ways that create unique difficulties, it is concerning to observe that it is not distributed equally. Not only does it vary by income, household composition, and age, but it is also unequally divided between women and men. Women are likely to travel farther and for longer for care-related purposes than men whether or not they have children, live with a spouse, or work for pay outside the house. This inequality is also generally consistent across income and age. Comparisons to similar research in Canada (Ravensbergen et al., 2022), Spain (Gomez Varo et al., 2023; Sánchez de Madariaga & Zucchini, 2020), Latin America (Murillo Munar et al. 2023), and more have shown that Mobility of Care in the Netherlands is more gender-equal than elsewhere in the world, but there is still progress to be made. Care labor and care travel remain disproportionate burdens to women in the Netherlands even though women work for pay at almost the same rate as men.

5.2 Regression Analysis

The results of the regression analysis are in-line with findings of previous studies that quantified Mobility of Care and found that driving is the predominant mode used for such travel (Ravensbergen et al, 2022; Sánchez de Madariaga & Zucchini, 2020). However, the association of Mobility of Care with driving that is observed in this analysis appears to be less strong than observed in Montreal, Canada (Ravensbergen et al, 2022) and Madrid, Spain (Sanchez de Madariaga & Zucchini, 2020). The fact that no change in the likelihood of public transit use was observed between care and non-care related trips (holding other factors constant) in this analysis is surprising given previous findings that Mobility of Care was less associated with public transit than are other trip purposes (Maciejewska and Miralles-Guasch, 2019; Ravensbergen et al., 2022; Villafuerte-Diaz et al., 2023). However, the connection of Mobility of Care with bus, tram, and metro usage shows considerable variation between Amsterdam, Utrecht, Rotterdam/The Hague, and the country as a whole, indicating that local factors not measured in the ODiN may have an important effect on this relationship.

The drop in the likelihood of bicycling or walking for Mobility of Care relative to other travel purposes is striking in a country with very high use of active modes. The needs of Mobility of Care appear to make such travel less suited to cycling or walking than other daily mobility,

despite the general prevalence of these modes in the country. Despite the country's world-leading investment in bicycling infrastructure and walkable urban spaces, Mobility of Care travel remains less likely to use active modes than other trip types. However, over a third (36%) of Mobility of Care trips in the sample overall were made either on bicycle or on foot. This is not a small proportion and is much higher than the rate in other contexts where similar studies have been conducted (Craig & Van Tienoven, 2019; Sanchez de Madariaga & Zucchini, 2020; Ravensbergen et al., 2022).

Furthermore, the fact that the odds ratio of Mobility of Care for electric bicycles is higher than for conventional bicycles indicates that electric bicycles may offset some of the disadvantages that bicycling creates for care travel, such as by extending the feasible range of trips, enabling travelers to carry heavier loads, and facilitating cycling by elderly or pregnant travelers. Previous studies quantifying Mobility of Care in other contexts have not considered electric bicycles because of their rarity. This analysis did not consider the potential additional effect of cargo bicycles (*bakfietsen* in Dutch), which are becoming popular in the Netherlands and are increasingly being used as a substitute for driving when traveling with young children or heavy cargo (Sun et al., 2020). *Bakfietsen* are already strongly associated with travelers (mainly women) escorting children, but their use is currently more common by wealthier and highly educated families (Mecking, 2018). As the technology becomes more widespread and cheaper, it is possible that the diffusion of bakfietsen, especially electric *bakfietsen*, will increase cycling rates for Mobility of Care in the Netherlands among a more diverse population.

By contrast with active modes, traveling for care is not associated with a change in likelihood of taking public transport when compared to other trip purposes, holding other factors constant. This is an encouraging finding from a transportation planning perspective, as it indicates that despite Mobility of Care travel having different needs from other travel purposes, individuals use bus, tram, and metro for both types at essentially equal rates when holding other factors constant. This is unusual in the literature on Mobility of Care, but consistent with the high levels of investment in and service offered by public transit systems in the Netherlands. That being said, bus, tram, and metro trips made up only 2.1% of trips in the sample, and only 1.5% of Mobility of Care trips. Even in Rotterdam/The Hague, the city with the highest rate of public transit use in the sample, only 8.6 % of care trips and 10.0% of non-care trips were made by bus, tram, and metro. Essentially, it is more relevant to say that public transit as a mode is equally *unlikely* to be chosen over driving for Mobility of Care as for any other trip purpose, holding other factors constant.

The nature of Mobility of Care travel, which frequently involves challenges such as accompanying dependents with low mobility, carrying additional items, and traveling on an as-needed rather than a regularly-scheduled basis, creates difficulties for travel by train, public transport, bicycle, and walking. Some of these challenges, such as the need to escort dependents with limited mobility, are inherent to Mobility of Care and must simply be managed by transportation planners, but some challenges arise from the design of the transportation system itself, such as the degree to which public transport networks serve care-related destinations. That the use of each travel mode for Mobility of Care varies between Amsterdam, Rotterdam/The Hague, Utrecht, and the country as a whole demonstrates that urban form and governance can have an impact on how travel for care is accomplished.

6. Conclusions

This thesis used data from the Dutch National Travel Survey to create an exploratory analysis of Mobility of Care in the Netherlands, drawing on Sanchez de Madariaga & Zucchini's (2020) methodology for extrapolating care as a travel purpose. This was done via an investigation of how Mobility of Care trips differ from other trip purposes, with an emphasis on how such trips are split between men and women, followed by a multinomial logistic regression analysis to determine how care-related travel is related to choice of travel mode.

Mobility of Care was found to be either the first or second largest travel purpose observed in adults' daily travel in the Netherlands, depending on the metric used. Importantly, Mobility of Care trips also look very different from trips for other purposes such as commuting, leisure, or education. They are more evenly distributed throughout the day, are generally shorter and quicker, and more frequently done in trip chains. Furthermore, women are likely to travel farther and for longer for Mobility of Care than men whether or not they have children, live with a spouse, or work for pay outside the house. This inequality is generally consistent across income and age, although it is smaller than the gender gap in other countries.

This analysis also demonstrates that Mobility of Care is a predictor of travel mode selection. Traveling for care is associated with a decreased likelihood of taking the train, cycling, or walking instead of driving when compared to other trip purposes, holding other factors constant. This supports previous findings that active modes are less commonly used for Mobility of Care than for other trip types. By contrast with active modes, traveling for care is not associated with a change in likelihood of taking public transport when compared to other trip purposes, holding other factors constant. This contrasts with previous findings that public transport is less commonly used for care-related travel, but it may largely be a result of overall low usage of public transport in the sample compared to other modes.

For this research, a number of limitations were identified. Firstly, the fact that respondents could only self-identify as either male or female limits the analysis to a binary concept of gender without considering other gender identities that are likely relevant to individual care labor and Mobility of Care responsibilities. Furthermore, the limited data gathered on respondents' partners or other adults in respondents' household means that analysis of different household structures, such as different divisions of paid employment vs care labor and differences between heterosexual and homosexual couples, is not possible. These factors are likely to be relevant to Mobility of Care. Finally, while the analysis was limited to trips in the ODiN sample taken after nationwide COVID-19 travel restrictions were lifted in January, 2022, the continuing prevalence of COVID-19 over the sample year is likely to have altered daily travel patterns. However, the very recent data also present an opportunity to study current travel patterns, as the disruptions of the pandemic to individual mobility mean that data collected prior to 2020 may be less relevant going forward.

6.1 Recommendations for policy makers

This analysis has demonstrated not only that Mobility of Care is among the most prevalent travel motivations in the Netherlands, but also that broad inequalities in Mobility of Care burdens exist along gender lines. While households naturally divide labor and travel responsibilities between themselves, evidence suggests that women are consistently overburdened with care travel even when they also work for pay outside the household, and this gap appears to increase for couples with more children. Transportation planners have not traditionally considered Mobility of Care, or any other metrics of care travel, in studies of trip patterns. Yet the prevalence of this motivation and its connection to various inequities suggest

that it should feature more prominently in transportation policy decisions This study has not considered the influence of specific policies on Mobility of Care or the care travel gender gap and therefore can make no specific policy recommendations. However, policy makers should understand both the prevalence of Mobility of Care and the continuing existence of this gender gap, and evaluate decisions in terms of both how much they facilitate care travel and whether they are likely to increase or decrease this gap.

This analysis has further demonstrated that there are significant differences in the mode choice decisions that individuals make for Mobility of Care compared to non-care related travel. Respondents were more likely to drive for Mobility of Care compared to other trip types and less likely to walk or ride a bicycle. Planners should be aware of this evidence that suggests trips for Mobility of Care may be more difficult to shift away from driving and towards more sustainable travel modes relative to commuting, leisure travel, or other purposes. However, the negligible difference in bus, tram, or metro usage between care travel and other trips, as well as the higher relative usage of electric bicycles for care compared to conventional bicycles, indicates that planners could potentially encourage a shift of care trips to these modes and away from cars. In general, collecting data on Mobility of Care in future travel surveys to understand patterns of care travel will allow transportation planners to better support this type of travel and its unique requirements going forward.

6.2 Recommendations for future research

Research on Mobility of Care so far has not used a uniform calculation methodology to quantify this theoretical concept. While individual studies must work from the available data, this presents difficulties when comparing findings between papers that use different methodologies. Adopting a strategy such as the multiple levels of Mobility of Care used in this analysis could enable more useful contextualization and comparison of future studies.

Utilizing a broader concept of gender in future research is highly recommended when possible. Allowing respondents a range of gender options for self-identification would enable a more complete study of the impacts and distribution of Mobility of Care outside the gender binary. Furthermore, gathering data on Mobility of Care for a variety of household structures, especially non-traditional arrangements such as multigenerational households and non-heterosexual partnerships that may exhibit unique characteristics, would broaden the picture of care travel practices in the Netherlands.

This analysis has shown that there are important differences in the relationship of Mobility of Care and travel mode choices between the Netherlands' three major urban areas, Amsterdam, Rotterdam/The Hague, and Utrecht, despite these cities' considerable similarities. Further research focusing on these metropolitan areas, particularly using more granular location data to spatially map travel patterns, if possible, would be useful to better understand the extent that differences in urban form change Mobility of Care practices. Intercity comparisons could be very useful insofar as there are relevant differences in policy between these or other Dutch cities which could demonstrate ways that policy decisions can impact Mobility of Care.

Finally, the diffusion of electric bicycles and *bakfietsen* throughout the Netherlands seems likely to continue to reshape resident's Mobility of Care patterns and practices in the future. Further research into their use for care travel specifically would be enlightening.

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