Abstract

Bicycling is an active mode of transport with widely known health and environmental benefits. Governments all over the world have set goals aiming for a modal shift from motorized to active transport. However, women and men have different travel barriers and motivators when cycling. A good understanding of all genders’ demands and needs is vital in order to increase the cycling share.

Previous studies revealed that Spanish bicycle users are disproportionately likely to be men (60% men vs 40% women). The main purpose of this Master’s Thesis is to address the gender differences in cycling participation among the Spanish population. In order to do so, possible explanatory factors (such as individual characteristics, household responsibilities, physical environment, trip characteristics, safety concerns and cycling infrastructure design) influencing inequality in bicycle usage have been analysed and a survey has been conducted.

The situation in Spain differs from Norway, in such a way that the cycling gender gap is non-existent or very little among Norwegian cyclists. Thus, the second objective of this study is to analyse if there is any lesson that can be learnt from Norway.

Future studies should investigate in detail the association between gender equality and quality of infrastructures.

KEYWORDS:

Gender differences

Cycling behaviour

Possible explanations

Preface

This Master's Thesis is written by Nuria Pérez Brandón for the *Department of Civil and Environmental Engineering* at the Norwegian University of Science and Technology (NTNU). It is the product of work carried out during the Spring Semester of 2019 and it represents the last element of my Civil Engineering career.

The theme of the thesis was chosen at our own request. I find cycling very interesting and gender inequalities, in particular, an urgent issue that needs to be discussed. Therefore, the task comprises the analysis of gender differences in transport cycling in Spain, my home country.

Writing a scientific paper of this magnitude has been an exciting and challenging process that has taught me a lot. Therefore, I would like to thank my supervisor at NTNU, professor Eirin Olaussen Ryeng, for her valuable guidance through all this process.

I would also like to thank my family and friends for their support in every step of my studying career. Special mention to Chris, for changing my life forever in such a wonderful way.

Trondheim, June 2019.

Nuria Pérez Brandón

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List of Abbreviations

GEI	Gender Equality Index
MPD	Minimum Passing Distance
NCS	National Cycling Strategy
NTP	National Transport Plan
SiN	Safety in Numbers
PEEB	Plan Estratégico Estatal de la Bicicleta
TØI	Transportøkonomisk Institutt

1 Introduction

Cycling is an active mode of transport with widely known health and environmental benefits (Khreis et al., 2017). At the individual level, commuting cycling is negatively associated with overweight and obesity (Wen and Rissel, 2008) as it provides physical exercise for the cyclists improving their overall quality of life. At the network level, active travel can reduce traffic congestion associated with air and noise pollution, fuel consumption and therefore carbon emissions (Woodcock et al., 2007). According to the Special Eurobarometer 406, the large majority of Europeans believe that air pollution (81%), road congestion (76%), travelling costs (74%), accidents (73%) and noise pollution (72%) are the most important problems within cities. Thus, governments all over the world have set goals for increasing the active mode share (Pan-European Programme, 2014) aiming for a modal shift from motorized to active transport.

Transport is a fundamental good that plays a vital role in contributing to all Sustainable Development Goals as it ensures accessibility to opportunities for all at all ages (TWG, 2015). Active modes such as walking and cycling are suitable for all age groups as they do not require special skills. Therefore, in order to encourage people to cycle, bicycle facilities must ensure a safe and feasible mean of transport for everyone (Dill et al., 2012).

The aim of this thesis is to give the reader acquired data so a profound comprehension of the problem stated can be accomplished.

1.1 Problem Statement

Women are more likely to walk (Laverty et al., 2013; Panter et al., 2011; Yang et al., 2012) or to use public transportation (Laverty et al., 2013) than men, but less likely to make use of private transportation or bike to work/school (Garrard et al., 2006; Laverty et al., 2013; Panter et al., 2011; Yang et al., 2012).

Women and men often have different travel barriers, needs and motivators. In 1999, a survey on transport was carried out in Vienna. Residents of the city were asked how often and why they used public transportation. Men and women disagreed in multiple issues, so measures such as better lighting to make walking and cycling safer in the dark, or widening pavements to make it easier to walk with strollers have been taken to make Vienna more attractive for women (City Lab, 2013). The Austrian capital is now known as one of the most liveable cities in the world (Bike Life report, 2018). Another example is the gender-equal snow-clearing policy set up in Stockholm within the past years. The vice mayor of the Swedish capital stated that, in the mentioned city, women walk, cycle and use public transport more than men do. Therefore, female-dominated modes of transport should be safer and thus, it is important that snow-clearing prioritises walkways and cycle paths (The Local, 2016). Hence, in order to reduce the cycling gender gap, it is necessary to take action to understand and fulfil the needs of all genders.

In general, cycling helps women to be more independent but several studies have shown that the traditional culture of gender segregation of labour (i. e. gender gaps in caring children and housework) may hinder women's participation in cycling (Peters 2001). A gender balanced representation in positions of power is likely to switch the priorities of transport politics (Aldred et al., 2016) in such a way that, women's participation in transport cycling is higher in EU countries with higher scores on Gender Equality Index (GEI) (Prati, 2018).

Moreover, previous research conducted in the field of gender differences in transportation has proved that countries where bicycle commuting account for high portion of the total number of trips made, have a much greater gender balance and women tend to commute by bicycle as much as men do (Pucher and Buehler, 2008; Fishman et al., 2015).

1.2 Aim of the Research and Research Question

Above all, the main purpose of this research is to address the gender differences in cycling participation in Spain. Possible explanatory factors that influence inequality in bicycle usage will be studied in detail. In that way, both Spain and Norway will be compared.

Therefore, the following research questions have been developed:

- **“Is it possible to explain the reasons behind the existing cycling gender gap in Spain?”**
- **“What outcomes can be taken from Norwegian cyclists?”**

1.3 Structure of the thesis

This Master’s thesis will be split into seven main chapters:

1. Introduction
2. Background
3. Research methodology
4. Possible explanatory factors affecting cycling gender gap
5. Survey
6. Results
7. Discussion
8. Conclusion

Following the introduction, where the problem statement and the research question have been outlined, a description of the actual cycling situation in Spain and Norway will be given. Thirdly, an explanation and a justification of the various used research methods will be given. The fourth part of this thesis will focus on defining the possible explanatory factors affecting the cycling gender gap such as individual factors, household responsibilities, trip characteristics, safety concerns and cycling infrastructure design. In this chapter, the main emphasis will be put on explaining gender differences when considering each of the mentioned factors. Chapter five will present a survey conducted in Spain with the aim to explain why in general more Spanish men than women decide to cycle. Results gathered will be discussed in chapter six and finally a comparison between Norway and Spain will be carried out in chapter seven. The last part of this thesis will cover an overall conclusion and further recommendations for future outlines.

2 Background

In this chapter, the current cycling situations in both Spain and Norway will be addressed.

2.1 Spain

Spain is the largest country in Southern Europe, with a total area of 505,990 km^2. According to the latest census figures, the total population in Spain is estimated 46,7 million people (Spain Statistics, 2018), which means a population density of around 92 per km^2. Due to its large area, Spain has an extensive network of roads, railways, rapid transits, air routes and ports.

2.1.1 Cycling in Spain

A study, the Cycling Barometer (2017), was conducted in Spain to follow the evolution of habits and opinions as well as cyclists' demands and needs regarding the use of bicycle. The survey was carried out among residents of Spain between May and June, 2017. In total, 3204 people between 12 and 79 years of age answered the survey via telephone interviews (GESOP, 2017).

Results revealed that only seven percent of the Spanish population cycles every day or almost every day while 40 % never or almost never ride (Figure 2.1.). Furthermore, even though the Spanish population is comprised by a fairly equal number of male and female, bicycle users are disproportionately likely to be men (60% men versus 40% women) (Figure 2.2.). Moreover, according to the Cycling Barometer 2017 report, this proportion has remained the same since 2008 (GESOP, 2017).

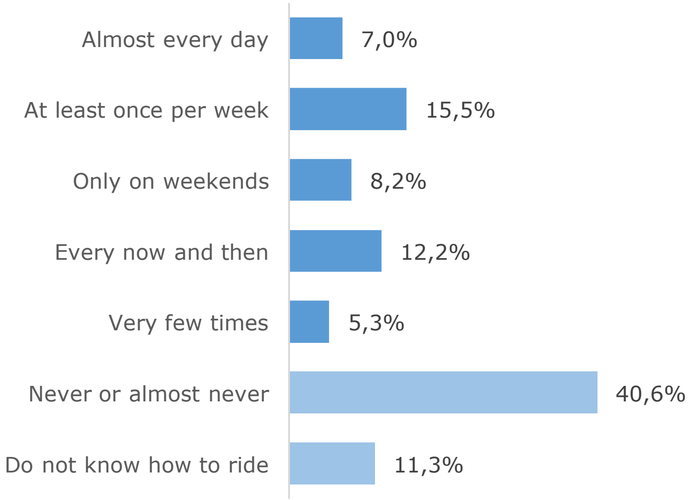


Figure 2.1: Bicycle usage frequency for any purpose in Spain (GESOP, 2017)

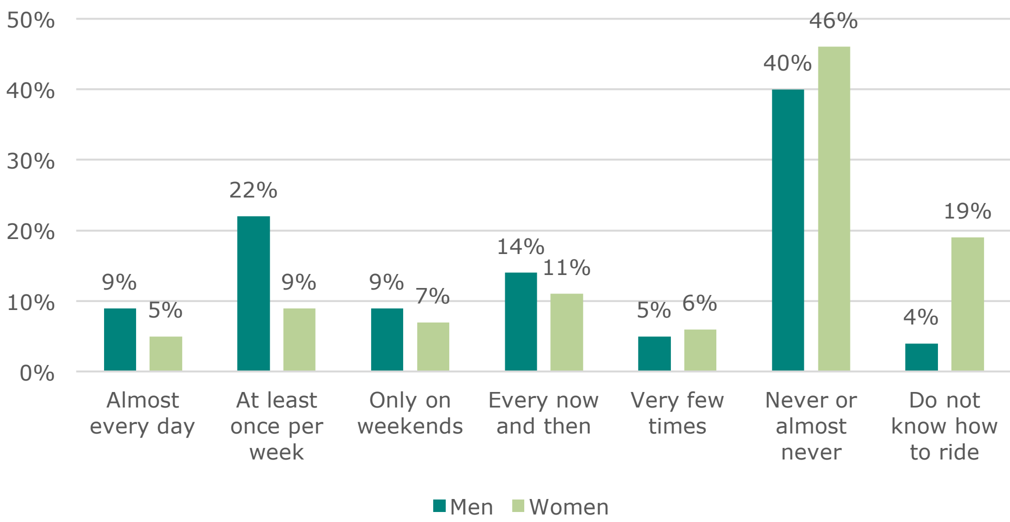


Figure 2.2: Bicycle usage by gender in Spain (GESOP, 2017)

2.1.2 Current cycling strategies in Spain

Bicycle commuting in Spain may not be as popular as it is in other European countries, but a National Cycling Strategy Plan (2019-2024) (Plan Estratégico Estatal de la Bicicleta (PEEB)) is being planned to promote a secure, comfortable and attractive use of the bicycle in Spain (DGT, 2018). Moreover, this PEEB is the first one being elaborated with a gender perspective in order to get more women to cycle (DGT, 2019).

PEEB is expected to influence bicycle commuting share in Spain positively, since it is following the Bike Masterplan approved in the city of Seville (Spain), where percentage of modal share for bikes went from almost zero to a nine percent of the total mechanical trips in five years (Marqués et al., 2014). In addition, according the Eco-counter EU analysis, bicycle traffic has been increasing in Spain since 2014 (Eco-counter, 2017). (Table 2.1.).

	2013-2014	2014-2015	2015-2016	2016-2017
Spain	-2 %	8 %	Stable	2 %
Global	8 %	3 %	Stable	Stable

Table 2.1: Evolution of worldwide cycling index (Eco-counter, 2017)

2.2 Norway

Norway is a country with a total area of 385,252 km^2 and 5,312,300 inhabitants (Statistics Norway, 2018). That is, a population density of around 15 per km^2. Norway has the lowest population density in Europe after Iceland. However, three-quarters of the population live in cities and towns, where the population density is 1,947 per km^2 (Meld. St. 33, 2016-17). Due to the low population density, narrow shape and long coastlines of Norway, its public transport is less developed than in many European countries, especially outside the major cities (Meld. St. 33, 2016-17).

2.2.1 Cycling in Norway

A study, the Bicycle Survey (2017), was conducted in the cities of Oslo, Bergen, Stavanger and Trondheim, Bodø, Buskerudbyen, Moss, Nedre Glomma, Tromsø to elaborate on Norwegian cyclists and their cycling behaviour. The survey was carried out among residents in the mentioned cities during May and June, 2017. In total, 7274 people responded to the survey with respondents aged from 13 to 75+ (Bjørnson et al., 2018).

This survey included questions regarding frequency of cycling for transport, leisure and exercise purposes. Results showed that most cycling trips in these cities are taken as commute trips to and from work or school and that the cycling gender gap is non-existent or very little in all the cases (Bjørnson et al., 2018).

Figure 2.3. presents the average cycling shares regardless the purposes. The percentages of Figure 2.3. have been computed using data gathered among population from the mentioned cities.

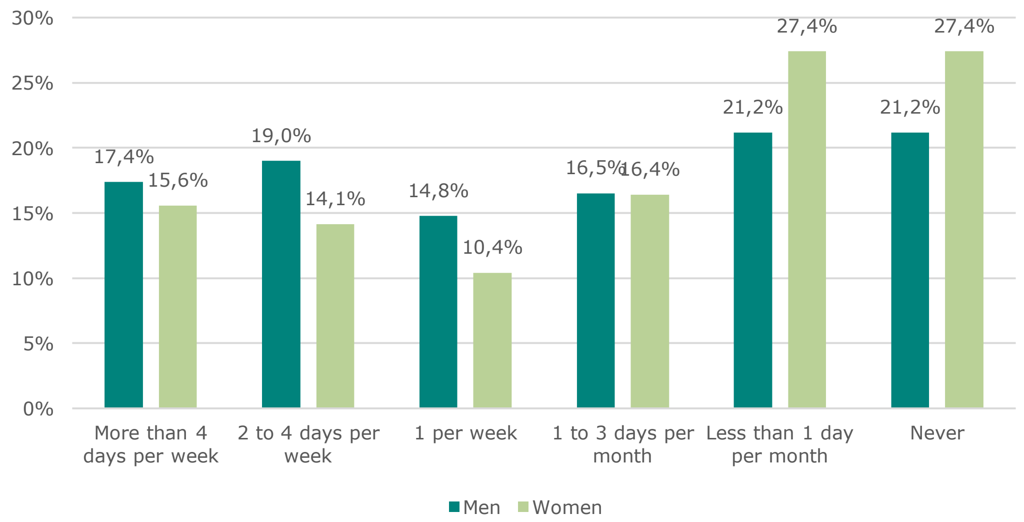


Figure 2.3: Average share by gender computed from questions "How often do you cycle at this time of the year?" in Norway (Bjørnson et al., 2018)

In addition, around four percent of daily trips in Norway (Figure 2.4.) are made by bicycle, but the cycling share is even higher in spring and summer (Hjorthol et al., 2014).

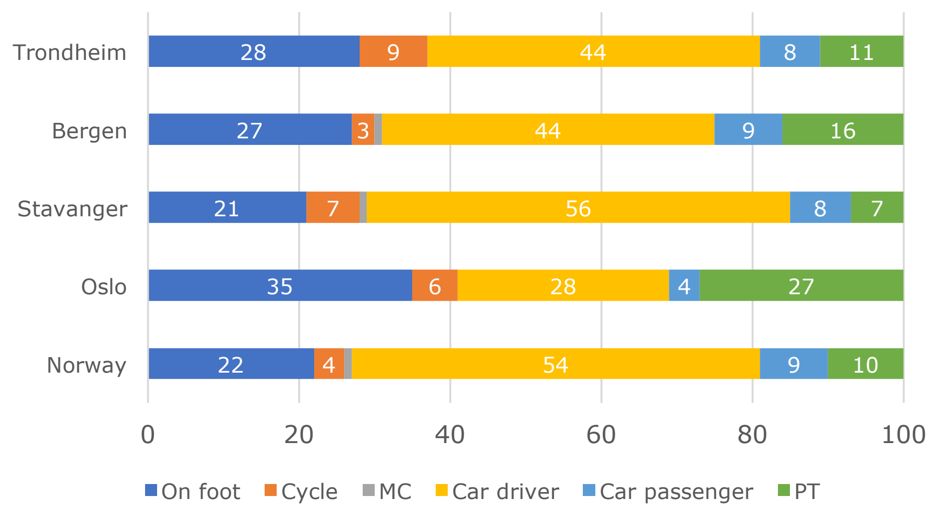


Figure 2.4: Modal share in Norway and selected cities in 2013/2014 (Hjorthol et al., 2014)

2.2.2 Current cycling strategies in Norway

The National Transport Plan (NTP) has set an ambitious goal for the largest cities in Norway, where all the future growth in individual travel should be accommodated by walking, cycling and public transport, thus no growth in car traffic (Meld. St. 33, 2016-17).

Moreover, the National Cycling Strategy (NCS) (2012) concluded that the potential for walking and cycling is quite high in Norway. If all trips as drivers of less than 5 km transfer to walking/cycling, the number of car trips would be reduced by 45 % (Hjorthol et al., 2014). NCS aims to make cycling safer and more attractive in Norway while increasing the share of cycling in the cities to 10-20 %. Its target is also to develop the main road network for cyclists with secure routes to school hence 80 % of children and youth can walk or cycle to school (Statens Vegvesen, 2003).

However, TØI forecasts for passenger transport for the period 2014-2050 (Table 2.2.) appraisal concluded that the estimated bicycle share's increase is lower than other means of transportation (Madslien et al., 2018).

	2014-2018	**2018-2022**	**2022-2028**	**2028-2040**	**2040-2050**
Motorcycle	1,9	1,5	1,2	0,8	0,6
Car Passenger	0,7	0,6	0,7	0,7	0,5
Public Transport	0,7	0,5	0,6	0,5	0,2
Bicycle	0,1	0,1	0,2	0,3	0,1
Walk	0,4	0,4	0,5	0,5	0,3
Airplane	1,5	1,3	1,2	0,9	0,7

Table 2.2: Estimated annual change in percentage for each mode of transport in Norway (Madslien et al., 2018).

3 Methodology

The developed research questions will be addressed by using different types of research methods. In order to answer the question successfully, secondary research in terms of a literature review, as well as primary research in terms of a survey will be applied.

In addition, an analysis of the collected data will be carried out as well as a comparison between Spain and Norway.

3.1 Literature review

In this section, the theoretical background of the study will be demonstrated. A methodological review of the past literature is a crucial activity for any research. The main focus will be put on topics such as gender inequalities in the fields of transportation. This theoretical background will provide a fundamental basis for conducting the survey later on in this thesis and helped to draw conclusions from the results obtained from the survey.

The majority of the literature comprises essentially research papers and articles. Although some literature has been provided by this thesis' supervisor. Most of the literature used in this study was written in English. However, since this Master's thesis directly compares cycling behaviour in Spain and Norway, literature in Spanish and Norwegian translated into English has been used as well.

The following words and combinations between them have been mainly used during the searching for relevant literature:

- Gender differences
- Gender equality
- Gender gap

- Inclusive cycling
- Cycling behaviour
- Transport cycling
- Factors influencing cycling
- Barriers and facilitators of cycling
- Change in mode of transportation
- Cycling in Spain and Norway

In general, it was easy to find studies on gender differences, while literature on some specific aspects related to the transport field was limited. It was not possible to find research on influences of cycling infrastructures' geometry (e.g. women may prefer wider paths whereas men may prefer coloured bike lanes) on individuals' decisions to cycle or not. After all, the main challenge was to find relevant studies from Spain and Norway, in particular.

The relevant literature found is described in detail in Chapter 4.

3.2 Survey

The data collected in this study will be obtained through a survey, which will be conducted online as well as in written form. Surveys are common procedures to learn about society's characteristics. The questionnaire is available in the appendix A.

3.2.1 Online survey

Online surveys are popular among other methods of collecting data because of advantages (Dell'Olio et al., 2018, p. 59) such as:

· Convenience: the respondents can fill in the questionnaire at their convenience. Given the widespread and increasing availability of smartphones, the public can answer the questions at any location and at any time.

· Visual support: web based surveys allow the use of visual and audible aids which can help to a better understanding of the questions asked.

· Speed: the information is directly collected digitally and the raw data is quickly available for processing.

· Cost/benefit: given that the entire process is more automatic, it is cheap to conduct this type of survey.

However, they do have certain disadvantages (Dell'Olio et al., 2018, p. 59) that need to be considered:

· Lack of interviewer: this is one of the main disadvantages. As there is no interviewer, the respondent can avoid certain questions, misunderstand them or superficially read the instructions for filling out the form which may lead to lower quality of the collected data.

· Limited access: given that to participate in this survey requires a computer or mobile phone with internet connection, the survey may only be accessible for part of the population. However, as previously mentioned in the advantages, internet availability is well widespread.

There are a large number of different ways of distributing a survey. In this paper, the survey was sent out via e-mail and it was also posted as a link on social media. Both methods are easy and fast ways of collecting responses because the respondents are reached out quickly and the chance of response is high (Jones et al., 2013).

3.2.2 Written survey

Written surveys are another way of collecting data. They have many advantages (De Leeuw et al., 2008, pp 134) such as:

· Well-trained interviewers: qualified staff is in charge of performing the interviews. Respondents will be able to understand all the questions.

· Personal contact: gestures and other possible verbal explanations are possible in written surveys. Comments from respondents while filling out the form are very helpful, and they usually provide insightful information that would have otherwise been lost.

· Universality: online questionnaires are simply not suited for some people (e.g. elderly people or poorly educated people). Some people may not have access to the Internet or may not know how to fill online questionnaires.

· Flexibility: written surveys allow little flexibility to the respondent with respect to response format.

However, they also have some disadvantages (Jones et al., 2013; De Leeuw et al., 2008, pp 134) such as:

· Cost/benefit: it is very costly to conduct this type of survey and quite inefficient as it is high time consuming and interviewers distributing the questionnaires are required.

· Presence of interviewer: the main advantage of the written form —the presence of an interviewer—is also its greatest weakness. Their presence may influence the answers respondents give, especially when sensitive questions are asked.

3.3 Data analysis

After a 3-week period time, the survey was deactivated. The majority of the answers have been collected digitally, by using computers, tables or smartphones. However, some of them have been collected in written form. In this case, questionnaires were printed and distributed among children and elderly people. Their answers have been digitalized in a database thus all the responses can be aggregated maintaining the coherence of the questions from the original online survey.

Once all the data has been digitalized, the obtained raw date will be processed mainly in *Excel*. First, the responses from *Google Forms* have been transferred to an *Excel* spreadsheet (.xlsx), where data has been divided into different sections depending on the factor to be analysed.

In all sections, total and gendered percentages of all the answers will be computed and represented on graphs in *Excel*. All the graphs are presented in Chapter 6, where they will be discussed in further detail.

In addition, in order to give an overview of the participants' characteristics (Table 6.4.), all the responses have been coded numerically, for example (1 = Not at all, 2 = Very little, 3 = Somewhat, 4 = Much, 5 = Very much). The average of all the answers has been computed and it is given in the mentioned table. Therefore, Table 6.4. provides a summary of the participants' preferences (on average) regarding habits, factors that influence (positively and negatively) participants' decision of cycling, what improvements (on-route and at destination) are needed according to the respondents, comfortability ratings and level of concern regarding several safety issues when cycling reported by all individuals in the dataset.

3.4 Comparison

In order to compare the cycling behaviour between Spain and Norway, results gathered in transport surveys and other studies among Norwegian and Spanish cyclists will be discussed.

A comparative method will be carried out. On the most basic level, comparing and contrasting involves the analysis of similarities and dissimilarities in a particular field (Esser and Vliegenthart, 2017). Associations between various aspects can be found by examining the available literature. Therefore, the aim of a comparative research is to obtain a better understanding of different societies (Spanish and Norwegian, in this case). The comparison of contexts serves as a way to check whether a relationship between various situations exists.

4 Explanatory factors affecting cycling behaviour

In this chapter, the possible determinants of active mode (cycling) choice will be evaluated. A revision of papers regarding cycling behaviour (Emond et al., 2009; Tulach et al., 2015; Grudgings et al., 2018; Lopez-Carreiro and Monzon, 2018; Prati, 2018; Xing et al., 2018) in the recent years allows to identify some of the most common motivations and barriers to bicycle usage. Differences in cycling behaviour are reviewed in general, but focusing on gender differences.

These determinants have been divided into six categories, which are individual factors, household responsibilities, physical environment, trip characteristics, safety concerns and cycling infrastructure design.

Even though household responsibilities could be included as an individual characteristic, it is considered of great relevance for this study. Domestic responsibilities affect substantially inequalities in cycling behaviour (Prati, 2018) and therefore will be studied separately.

This section will discuss the main findings from literature reviews that focus on cycling behaviour and gender differences, with respect to factors from each category. Existing studies of Spain and Norway in particular will be also included in each category.

4.1 Individual characteristics

4.1.1 Age

Tulach et al. (2015) observed that, at young ages, boys generally cycle more than girls and they do it on the streets while girls prefer riding on sidewalks. In addition, McDonald (2012) concluded that female pupils are less likely to have permission to bike to and from school without an adult in comparison to male students of the same age. Traditional overprotective parenting behaviour towards girls may also hinder their decision to cycle to school. Girls often tend to be considered more vulnerable and they are not allowed to be as independent as boys (McMillan et al., 2006; Shaw et al., 2013). If gender inequalities in cycling begin early in childhood, greater differences later in life may occur. However, such differences could be reduced. Parents serve as a role model and some studies confirm that those who ride influence to a great extent their children's decision to cycle more (Kerr et al., 2006).

When taking into consideration elderly people, cycling is very important since health benefits from cycling are higher at older ages (Woodcock et al., 2014).

SPAIN

According to the Cycling Barometer 2017 report, half of the Spanish bicycle users are younger than 40 years, being the 12-24 age group the one who reported riding more per week (28,7 %). It is relevant to mention that, among this age group, 31,2 % of users are boys while just 13,7 % are girls (Table 4.1.) (GESOP, 2017).

		Gender		**Age (years)**				
		Male	**Female**	**12-24**	**25-39**	**40-54**	**55-69**	**70-79**
USERS	Weekly	31,2 %	13,7 %	28,7 %	23,9 %	25,0 %	17,0 %	11,6 %
	Only on weekends	9,3 %	7,1 %	7,5 %	10,6 %	11,4 %	4,5 %	0,7 %
	At least once a month	14,1 %	10,4 %	20,5 %	12,9 %	12,9 %	8,0 %	4,1 %
	Less that once a month	4,5 %	6,2 %	7,9 %	5,5 %	6,8 %	3,0 %	1,4 %
NO USERS	Never or almost never	36,9 %	44,2 %	32,4 %	42,3 %	38,0 %	44,6 %	48,5 %
	Do not know how to ride	4,0 %	18,4 %	3,1 %	4,7 %	5,8 %	22,9 %	33,8 %

Table 4.1: Cycling share by gender and age (GESOP, 2017)

NORWAY

According to a National Survey in Norway (Hjorthol et al., 2014), the youngest age group has the highest cycling share. Users aged 13-17 account for 12 % while the cycling share is equally spread among the rest of the population (Table 4.2.).

Gender		**Age (years)**							
Male	Female	13-17	18-24	25-34	35-44	45-54	55-66	67-75	55-66
5 %	4 %	12 %	4 %	4 %	4 %	4 %	4 %	3 %	3 %

Table 4.2: Percentage of daily journeys riding by gender and age (Hjorthol et al., 2014)

However, when considering the young population riding to school, 13% are males while 8 % are females (Table 4.3.). Percentage is higher among children aged 12 and 15 years and decreases with age (Hjorthol et al., 2014). Previous studies (Carver et al., 2013; Horspool, 2006) show that cycling share usually decreases among teenagers because students at high school age are more worried about their image than students at school age. This is, adolescents generally consider cycling to school not *cool*, which leads to lower cycling rates (Horspool, 2006).

Gender		**Age (years)**		
Male	Female	12-15	16-19	20 or older
13 %	8 %	18 %	5 %	8 %

Table 4.3: Percentage of daily journeys riding to school by gender and age (Hjorthol et al., 2014)

Ryeng (2008) conducted a study about Norwegian children's mode choice when commuting to school. The share of children using the car as the most commonly used mode for trips to school was significantly higher for boys than girls at all ages (Figure 4.1.). The walking and cycling share increased with age until the age of 12. From the age of 13, public transport was the mode of transport chosen most often by children to go to school (Ryeng, 2008).

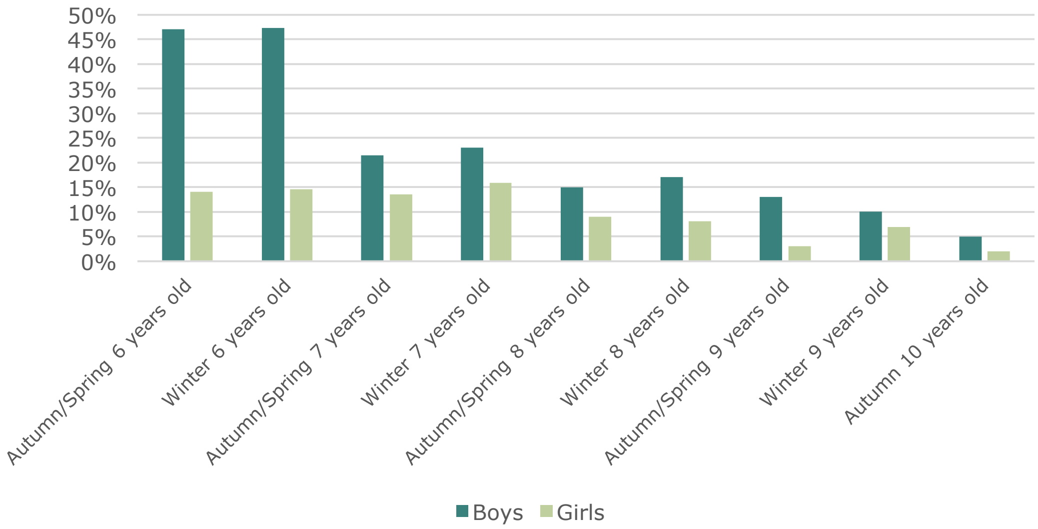


Figure 4.1: Share of children using car as the most common mode for trips to school by gender at different ages and seasons (Ryeng, 2008)

4.1.2 Biological differences: pregnancy

During pregnancy many women are motivated to modify their life style to healthier routines such as increasing moderate physical activity (Dencker et al., 2016). Exercising while pregnant is benefitial not only to improve the physical fitness (Nascimento et al., 2012; Kramer and McDonald, 2006; Ramirez-Velez et al., 2011) but it also lessens excessive weight gain (Muktabhant et al., 2015), lowers risks of pre-eclampsia and premature birth (Hegaard et al., 2007) and reduces anxiety and depressive symptoms (Da Costa et al., 2003; Robledo-Colonia et al., 2012).

Despite the mentioned benefits, 60 to 80% (Gaston and Cramp, 2011; Gjestland et al., 2013; Hegaard et al., 2011; Walsh et al., 2011) of pregnant women do not meet the physical activity recommendated levels. In general, a reduction in the physical activity is common among women when they get pregnant (Juhl et al., 2012; Liu et al., 2011; Owe et al., 2009; Pereira et al., 2007).

Low rates on cycling during pregnancy may be explained by the many barriers that expecting women face such as nausea, tiredness, lack of time or having other children (Edvardsson et al., 2011; Weir et al., 2010; Cioffi et al., 2010). Ultimately, simply the increment of size of pregnant bodies can be an obstacle big enough to hinder cycle-commuting (Edvardsson et al., 2011). Furthemore, cycling is considered to be more demanding, exhausting and dangerous than walking (Evenson et al., 2009), which may lead to pregnant women giving up on cycling due to their safety concerns (Pereira et al., 2007). However, past studies (Haakstad et al., 2007; Juhl et al., 2012) have revealed that pregnant women ride less in early pregnancy compared to pre-pregnancy mostly because of lack of social support and social judgement within their inner circle. Partners, in particular, but also family and friends, could take away women's desire to cycle.

SPAIN

According to a report on traffic accidents of pregnant women (RACC, 2015), Spanish pregnant women change their modes of transportation’s choice and they prefer walking or going by car as a passenger rather than cycling or driving themselves. Moreover, they were asked to rate the safeness, comfort and suitability of different means of transport from 1 to 5, being 1 = Not at all and 5 = Very much. The results are presented Figure 4.2., where the bicycle was the least rated regarding comfort and the second worst on safetyness and suitability (only before motorcycle).

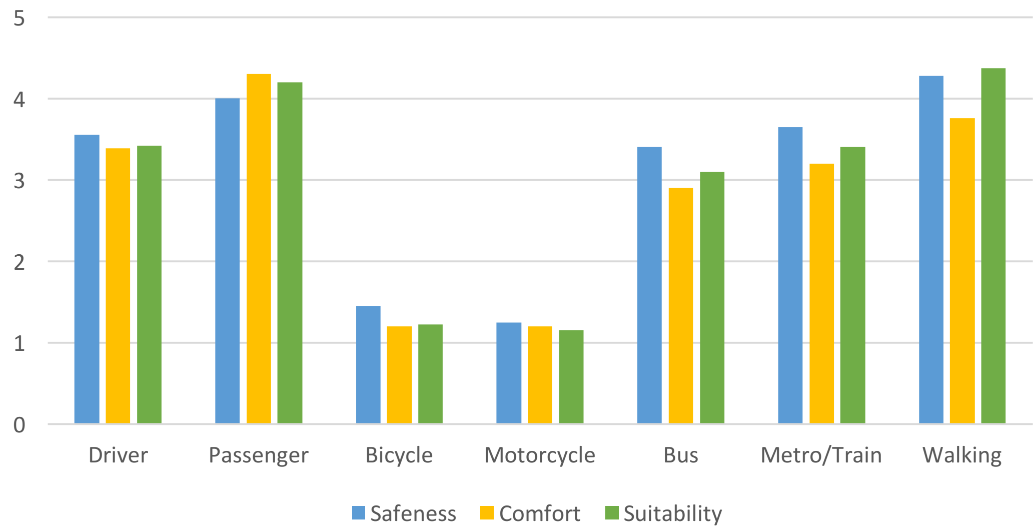


Figure 4.2: Ranking of different means of transport by Spanish pregnant women accounting safeness, comfort and suitability (RACC, 2015)

NORWAY

A Norwegian study (Skreden et al., 2015) about the changes in the choice of modes of transportation to go to work/school from pre-pregnancy to early pregnancy revealed that the greatest change was seen among the women who reported to bike before being pregnant as only 46% continued to bike in early-pregnancy. In the same study, pre-pregnant and early-pregnancy levels of physical activity were reported to be 97% and 81%, respectively, meaning that there was a decrease of 16 % once women got pregnant. In early pregnancy, fewer women biked whereas the use of private transportation increased (Skreden et al., 2015). Moreover, a study from Oslo reported that 53% of women used private and 32% public transportation to work during the third trimester of their pregnancy (Haakstad et al., 2007).

4.1.3 Physical shape

Lustyk et al. (2004) found that females were more likely to practise regular low-intensity activities whereas males were more likely to practise regular high-intensity activity. According to a 2017 report from the European Commission about sport and physical activity, men practise more moderate physical activity per week than women. Respondents were asked on how many days they did moderate physical activity like cycling at normal pace in the last seven days. In the survey, 42% of men reported not doing moderate physical activity in the previous seven days compared with 52% of women (Special Eurobarometer 472, 2017).

Broadly speaking, physical activity is a highly gendered health behaviour, where women are less likely to meet the minimum accepted levels of physical activity than men (Colley et al., 2011). Men exercise for social and competitive reasons (Silberstein et al., 1988) while women do it for appearance reasons such as to lose weight or to maintain weight loss (Furman et al., 2002; Prichard et al., 2005).

Findings indicate that activity levels increase during childhood but begin to decrease in puberty, particularly among girls (Norwegian Directorate of Health, 2012), which may be explained by the existing relationship between self-body image perception and physical activity level among girls (Davison et al., 2007; Kirkcaldy et al., 2002).

Previous research (Burnett et al., 2015) revealed that breast is often seen as an obstacle to sports participation. In Burnett’s et al. (2015) studies, girls reported that breast was their fourth greatest barrier to join exercise activities, after energy/motivation, time constraints and health. In another study (Scurr et al., 2015) about the breast’s influence on sport participation among female pupils, 73 % of the girls reported to have at least one breast-related concern when exercising. Their most common worries were breast bounce when doing exercise (38%) and embarrassment when getting changed due to breasts themselves or their bras (34%).

SPAIN

A Spanish survey (ENSE, 2011/2012) on reaching the World Health Organization recommended physical activity levels revealed that 68,7% of male adults (aged 18-69 years) achieved the advised levels whereas only 64,2 % female did. Percentages are lower among adolescents (11-17 years of age) of both genders. Boys accounted for 31,7 % and girls for 17,3 % (Table 4.4.).

Age (years)	Males	Females
Adults (18-69)	68,7 %	64,2 %
Adolescents (11-17)	31,7 %	17,3 %

Table 4.4: Percentage of Spanish adolescents and adults reaching the recommended physical activity levels 2011/2012 (ESNE survey, 2011/2012)

According to GESOP (2017), the biggest advantage of riding for Spanish males and females is that is a way of exercising (Figure 4.3.).

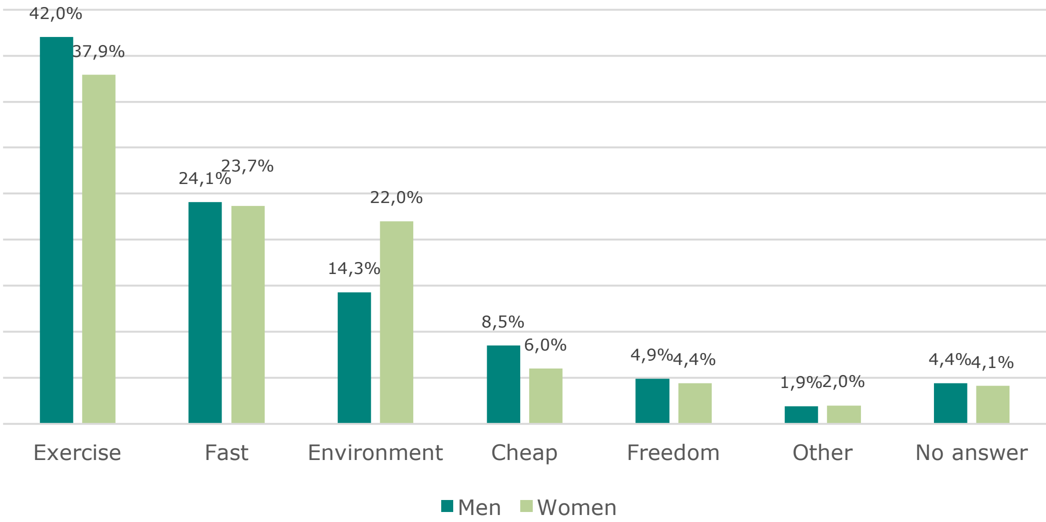


Figure 4.3: Main advantages of cycling in Spain by gender (GESOP, 2017)

NORWAY

A study by the Norwegian Directorate of Health from 2011 revealed that 58 % of 15-year olds boys and 43 % of girls achieved the recommended physical activity levels (Norwegian Directorate of Health, 2012). Percentages were even higher among a younger population (6 and 9 years). However, share was always higher for boys (Table 4.5.).

Age	Girls	Boys
6 years	87 %	96 %
9 years	70 %	86 %
15 years	43 %	58 %

Table 4.5: Percentage of Norwegian children and adolescents who meet the recommendations for 60 minutes of daily moderate physical activity (Norwegian Directorate of Health 2012)

Moreover, the Nord-Trøndelag Health Study (HUNT) includes a survey among citizens of Nord-Trondelag (Norway) aged 20 and up where people were asked how often they did exercise. 20,31 % of people answered that they exercised every day, 46,12 % of them responded that they performed exercise 2-3 times a week while just 1,92% reported never did (Figure 4.4.) (HUNT3, 2008).

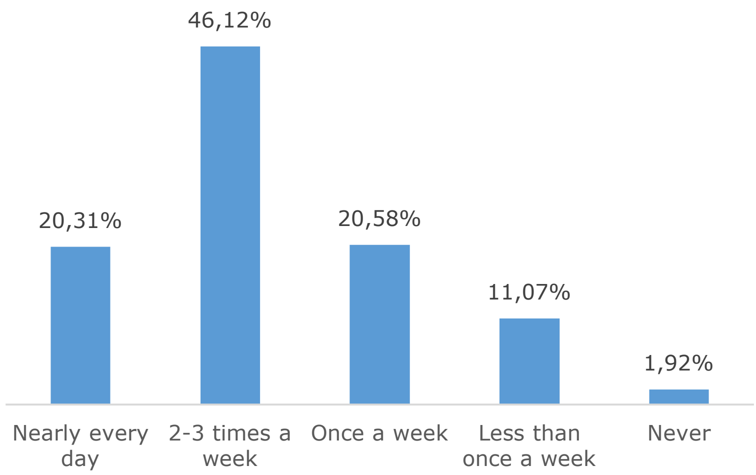


Figure 4.4: Nord-Trøndelag population's responses to the question "How often do you exercise?" (HUNT3, 2008)

4.1.4 Education and training

Experts suggest that bicycle training programs have potential for increasing bicycling levels (Pucher et al., 2012). Previous reviews suggest that training can narrow the cycling gender gap (Transport for London, 2016). And that young girls' cycling can nourish from encouragement in such manner that bike skills training at early ages may ensure long term impacts, addressing gendered barriers and facilitating cycling for female teens and women (Sersli et al., 2018).

According to the GESOP (2017), women who do not know how to ride in Spain outnumber men by a ratio of more than 4:1 (18,4 % and 4 %, respectively) (Table 4.3.). This percentage doubles (33,8 %) when looking at individuals older than 70 years. The proportion of people who do not know how to cycle is also higher amongst individuals who have a low educational level (20 %) compared to people with a higher level of education (4 %).

4.1.5 Personal preferences

Previous research on bicycling has analysed the importance of personal preferences when deciding in favour or against the use of bikes in the city. Findings indicate that walking and cycling journeys are the most relaxing and exciting (Gatersleben and Uzzell, 2007). Feelings of happiness and excitement are connected to the sensation of freedom and are, therefore, considered good sensations that will positively affect personal preferences. Still, riders can also experience negative emotions when cycling due to fear of having an accident, which may hinder their decisions in a negative way.

Habits and social norms are very important as well. Many people report that they do not commute by bike because they are not willing to change their habits of using other means of transportation, which typically means private cars (Rimano et al., 2012).

Some studies (Green et al., 2012) indicate that both physical appearance and clothing affect the personal decision of females to cycle. In particular, some women have reported being negatively affected by the fear of attracting unwanted harassment from men when wearing cycling outfits (i.e. lycra) (Garrard et al., 2006).

Both Spain and Norway are countries with quite low cycling rates (previously mentioned). Aldred et al. (2016) claimed that women tend to cycle less than men in countries with low riding rates. Yet, even though the cycling share is low in Norway, there is no significant gender inequality among Norwegian cyclists.

When the participants of the Cycling Barometer (2017) survey (GESOP, 2017) were asked about the reasons why they do not ride, the most mentioned was not being used to cycling. Some people stated that they prefer driving their cars and walking but only a few of them said they do not cycle simply because do not like riding (Figure 4.5.).

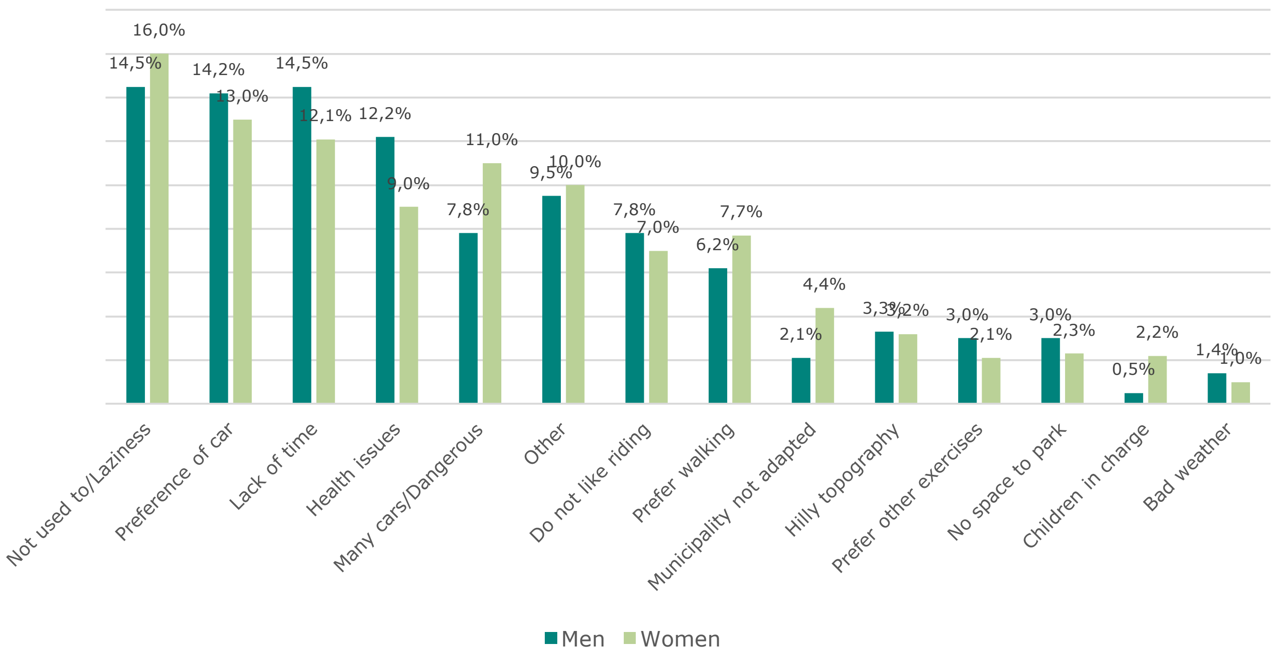


Figure 4.5: Answers to the question "Why do you not ride?" by gender (GESOP, 2017)

4.1.6 Car ownership

Individuals who do not own a car are likely to bicycle more per week compared to people who own a car (Lusk et al., 2014). Young people tend to decline bicycle as an option when they receive their driver's license (Tulach et al., 2015). However, several studies have shown that rates of automobile use are falling among millennials (young adults between 18 and 36 years) as they seem to be less car-oriented than previous generations (Davis et al., 2012), which may simultaneously lead to reconsideration of bicycling.

Moreover, according to Buehler et al. (2012), there is also a positive linking between the gasoline price and the percentage of commuting cycling trips.

SPAIN

According to the Eurobarometer report on attitudes of Europeans towards Urban Mobility, 38 % of Spaniards use a car (whether as a driver or a passenger) at least once a day while only 18 % never do (Special Eurobarometer 407, 2013).

NORWAY

In Norway, according to a National Survey (Hjorthol et al., 2014), 91% of the adult population has a driving licence and the large majority (88%) of the Norwegians have access to at least one car. However, according to the same survey, accessibility to a car is lowest among age group 18-24 and women (Hjorthol et al., 2014).

4.2 Household responsibilities

Rosenbloom and Burns (1993) noted that gender inequalities in the different roles assigned to women by society (e.g. household and child care duties) may interfere in women's travel patterns. Even though women are working outside home now more than ever, working and lifestyle characteristics of women and men still present differences.

As already mentioned before, recent findings have demonstrated that women's participation in transport cycling is higher in EU countries with higher scores on GEI (Prati, 2018). Specifically, as the score of gender equality increases, the percentage of women reporting never cycling decreases (Figure 4.6.).

In this sense, according to the last Global Gender Gap report (2017), Norway is in second place while Spain is in 23rd position.

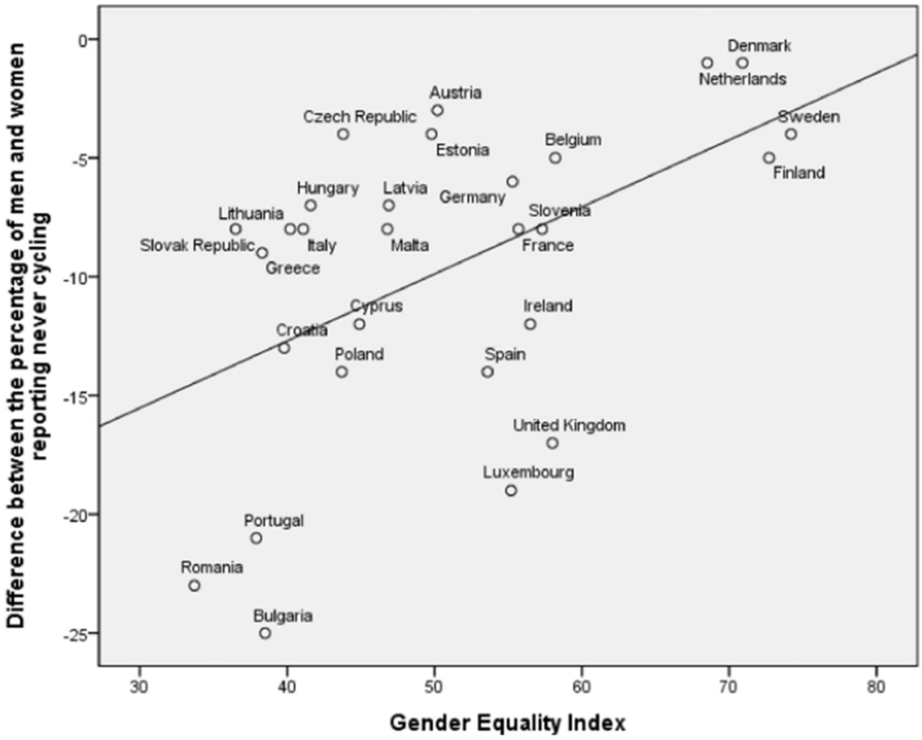


Figure 4.6: Difference between the percentage of men and women reporting never cycling and GEI for each EU country (Prati, 2018)

4.3 Physical environment

4.3.1 Climatology

The season of travel is known to influence active mode choice (cycling and walking), with summer and autumn being the most favourable periods (Heinen et al., 2010). Precipitation and temperature have a strong influence on the choice of bicycle commuting. Flynn's et al. (2011) findings also pointed out that warmer temperatures increment the probability of riding. However, extreme weather lowers the participation rate, frequency and duration of physical activity (Spinney et al., 2011). Yet, whereas temperature, sunshine and wind are equally relevant for both genders, rain is of greater concern to women (Grudgings et al. 2018). In addition, fear of becoming sick due to bad weather conditions, diseases such as asthma or the flu, might also lower people's activity levels (Chan et al., 2009).

SPAIN

In Spain, Lopez-Carreiro and Monzon (2018) evaluated the cycling behaviour in Vitoria-Gasteiz (Spain). The research was based on a previous survey (2014 Household Mobility Survey) carried out in the same municipality. In this study, climatology was perceived as the second worst-perceived factor by all age groups (18 to 72+ years old). In addition, according to the Cycling Barometer 2017, 5,7% of male and 6,5 % of female Spanish cyclists considered weather a constraint when deciding whether to cycle or not (GESOP, 2017).

NORWAY

Kummeneje et al. (2018) studied the seasonal variation in risk perception and travel behaviour among cyclist in Trondheim (Norway). The study was based on an online survey through a website for cyclists in Trondheim. The results showed that risk perception and fear were important factors in cyclists' decisions to ride during wintertime. Absence of light and icy paths pose a higher challenge to cycle during cold seasons in Norway. The probability of being involved in an accident in winter was judged to be higher. This study also revealed that women tended to tolerate risk less than men and they were more worried and perceived the risk of accident as higher compared to men.

In addition, research shows that, on average, Norwegian children walk and cycle more frequently during spring and autumn compared to winter (Ryeng, 2008).

4.3.2 Green areas

Findings show a positive association between active mode use and the presence of parks and vegetation (Wang et al., 2016; Fraser and Lock, 2010; Heinen et al., 2010). The presence of green spaces has been associated with better perceived general health, reduced stress levels, reduced depression and more (World Health Organization, 2016). The presence of parks increment leisure physical activities in cities (Bedimo-Rung et al., 2005; Mytton et al., 2012). In particular, trees can produce oxygen, reduce on-site heat of paved surfaces and serve as route-guiding (Mårtensson et al., 2009).

Moreover, Krenichyn (2006) studied women's experiences when exercising while being outdoors. Results showed that female enjoyed more practicing physical activities in the park because of the sceneries but also because they felt more comfortable and less susceptible to unwelcome comments (such as catcalls) when exercising in the park in contrast with the harassment experienced when in the street (Krenichyn, 2006). Thus, appropriately managed green space may offer women opportunities to be more physically active than in other urban contexts (World Health Organization, 2016).

Positive associations between green areas and mental health differ from women to men. Van den Bosch et al. (2015) found significant correlations between improvement of mental health and the access to calm green areas within women but not men. There is also evidence of beneficial effects for pregnant women when they have access to green spaces as it reduces blood pressure and depression in expecting mothers (McEachan et al., 2016; Grazuleviciene et al., 2014).

4.4 Trip characteristics

4.4.1 Travel distance and time

Distance and travel time are the most examined trip characteristics and they are sometimes considered equivalent (Ton, 2013). However, distance is most often investigated (Handy et al., 2014; Heinen et al., 2010; Muñoz et al., 2016).

Growth in distance generally discourages travellers from cycling due to the raise in the physical effort needed (Van Wee et al., 2006). Yet, Keijer et al. (2000) suggested that for trips up to two kilometres, the bicycle is a less attractive mode of transport and individuals prefer walking.

Women tend to live closer to the workplace (Schintler et al., 2000; McGuckin et al., 2005), which means they perform shorter commute trips. Moreover, women are more prone to chain trips, carry goods and take passengers (Aldred et al., 2016; McGuckin et al., 2005), which is more complex to accomplish by bike. In fulfilling the said duties, women tend to have time-constrained schedules that require fast and efficient transportation modes (Zhou et al., 2005). According to the EU Cycling Economy report (2016), the presence of children plays an important role in incrementing the probability of car use for women.

Women tend to cycle shorter distances per trip compared to men (KiM, 2016). Thus, gender differences may also be explained by the nature of a typical transport cycling journey in Spain in comparison to Norway since the average cycle commute trip length is generally higher in Spain (6,58 km) than in Norway (3,79 km) (Data collected through surveys conducted by numbeo.com from January, 2011 to February, 2014).

In Norway, most trips (68%) under one kilometre are carried out on foot and the majority of trips over one kilometre are done by car. The share of public transport increases with increasing travel length. Between six and eight percent of the trips under five km are made by bicycle (Hjorthol et al., 2014). (Figure 4.7.)

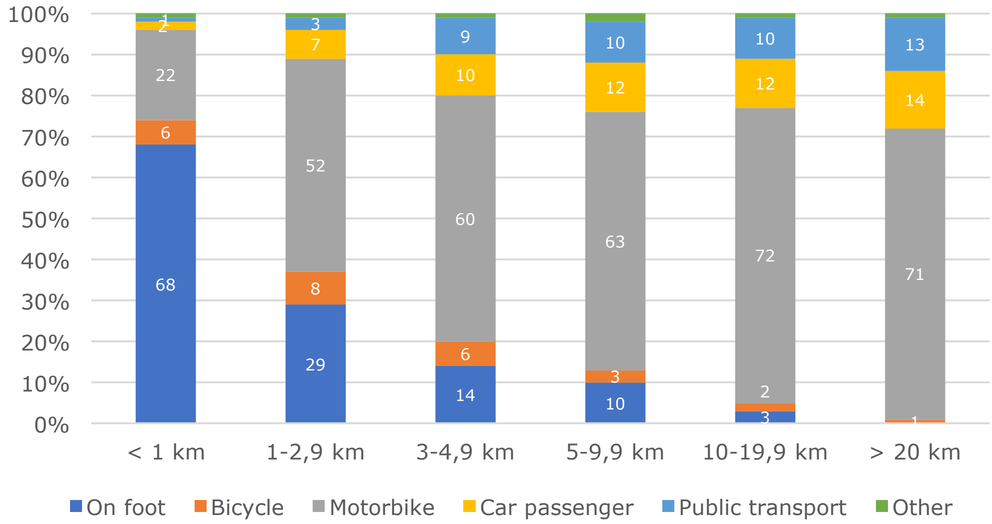


Figure 4.7: Travel lengths for different means of transport in Norway (Hjorthol et al., 2014)

4.4.2 Purpose

Cycling activities can be divided into two different forms according to their purposes: transport and leisure. Leisure physical activity's aim is to body-building or simply to socialize whereas transport physical activity's goal is to reach a desired destination (Wang et al., 2015). Cycling to work/school can also be considered as a way to perform exercise but, unlike recreational riding, bicycle commuting is often performed individually rather than with friends (Molina-García et al., 2016) and therefore, it is not registered as a leisure activity.

Biernat et al. (2018) studied the motivations and barriers regarding bicycle commuting in Poland and found out that there are four types of cyclists (the *conscious*, the *forced*, *pro-*

health and the *lifestyle* cyclist) with different reasons for choosing to ride. Motivations of each type are summed up in the following figure (Figure 4.8.).

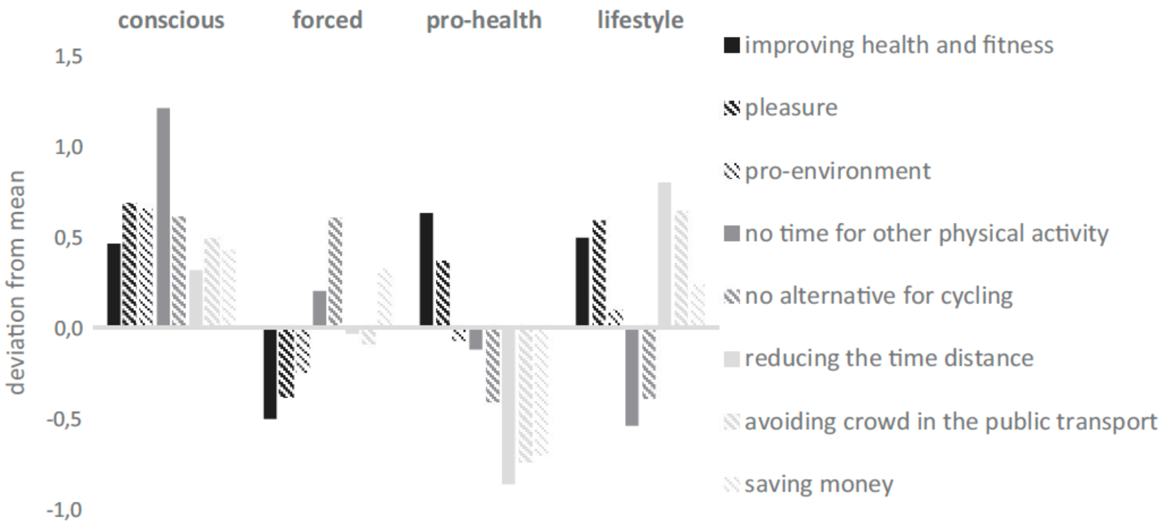


Figure 4.8: Types of cyclists according to their interests (Biernat et al., 2018)

<u>SPAIN</u>

In Spain, only around 14 % of the population commute to work or school by bicycle weekly (GESOP, 2017), whereas 37,7 % cycle for exercise purposes and 36,5 % for leisure purposes (Figure 4.9.). Thus, Spanish could be defined as *pro-health* cyclists (see Figure 4.3.), who "perceive cycling as health, fitness, and pleasure-related, but disregard all other aspects" (Biernat et al., 2018).

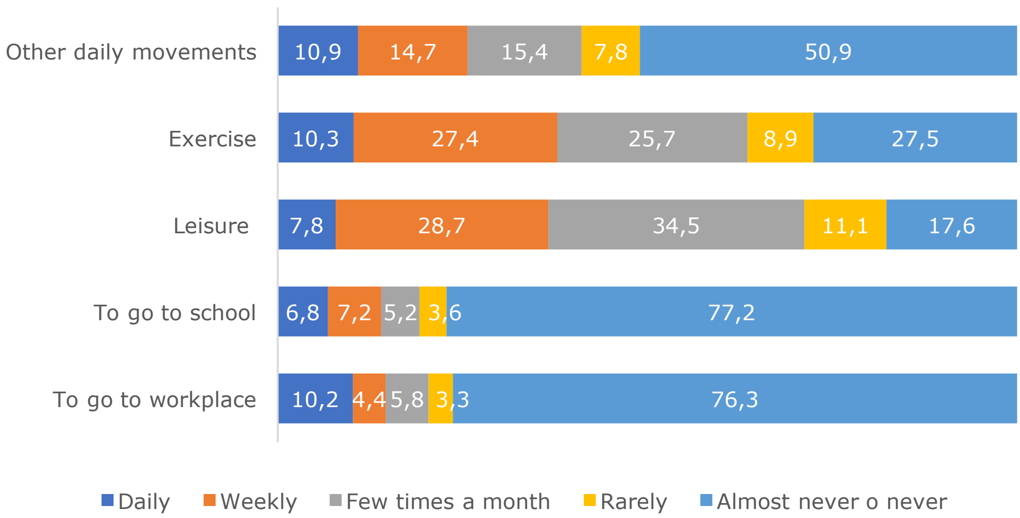


Figure 4.9: Percentages of share of cycling purposes in Spain (GESOP, 2017)

NORWAY

The majority of cycling trips in Norway are from/to work while exercise and leisure accounts for only smaller percentages in all cities (Figure 4.10.). Thus, Norwegian could be defined as *forced* cyclists. For them, "the key motivation is no alternative for cycling, while other reasons are rated relatively less important" (Biernat et al., 2018).

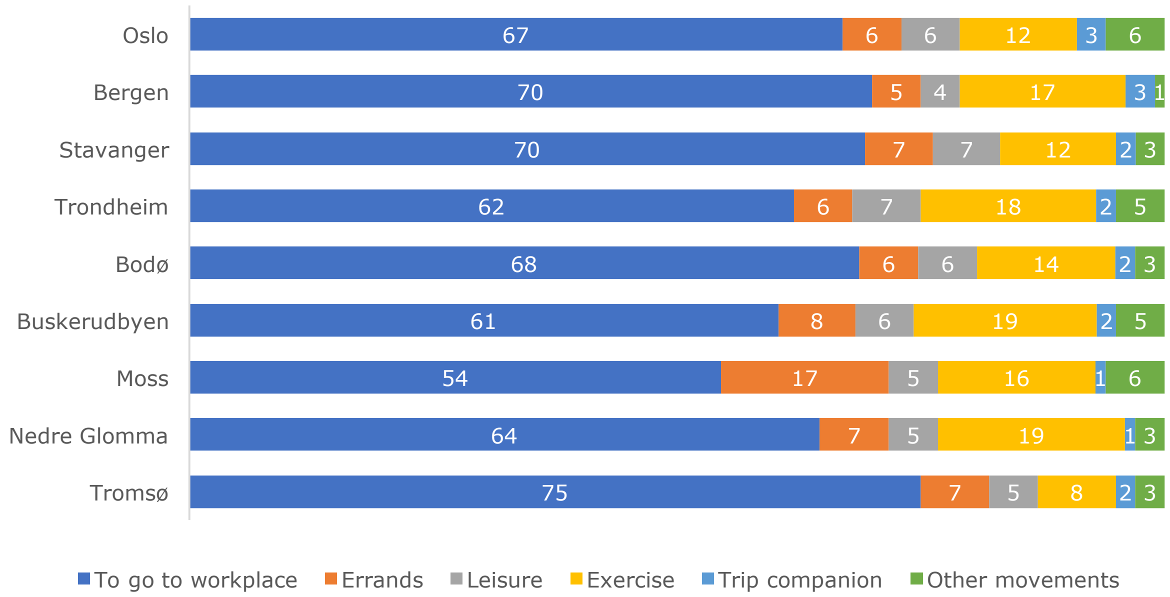


Figure 4.10: Percentages of share of cycling purposes of total km cycled last day in Norway (Bjørnson et al., 2018)

Cycling share commuting to and from work and school account for seven percent and 10%, respectively. The most common mode of travel on purchasing trips is clearly the car (70%) contrary to the bicycle, which accounts for only three percent. For leisure trips, on foot and going by car are again the most common modes while five percent of the trips are made by bicycle.

4.5 Safety

Cycling has many benefits but it also comes along with safety issues as 8% of all road fatalities in EU countries are related to cyclists (European Commission, 2015). Moreover, cyclists are vulnerable road users because they do not have any physical skeleton that protects their body. Therefore, cyclists have a higher proportional risk of being severely injured in collisions than motorized vehicle passengers (Chaurand and Delhomme, 2013).

Based on the Norwegian National Travel Survey and accident statistics from 2013/2014, te risk of cyclists being killed or seriously injured is 13 times more than car drivers (Table 4.6.) (Meld. St. 40, 2015-2016).

Road user groups	Number of people killed or seriously injured per million person kilometres	Risk compared to risk for car drivers
Car drivers	0,007	1
Car passengers	0,006	0,9
Pedestrians	0,058	8
Cyclists	0,090	13
Moped	0,055	8
Light motorcycle	0,370	53
Heavy motorcycle	0,115	16

Table 4.6: Comparison of the risk of being killed or seriously injured for different road user groups (Meld. St. 40, 2015-2016)

Safety risk of cycling is a concern for all bicycle users that reduces the possibilities of people's choice of riding (Lawson et al., 2013; Sanders, 2015; Winters et al., 2012). However, women face personal safety in a different way and comfort seems to be more important to women than to men (Whitzman, 2007; Heesch et al., 2012), which may contribute to gender differences in travel behaviour.

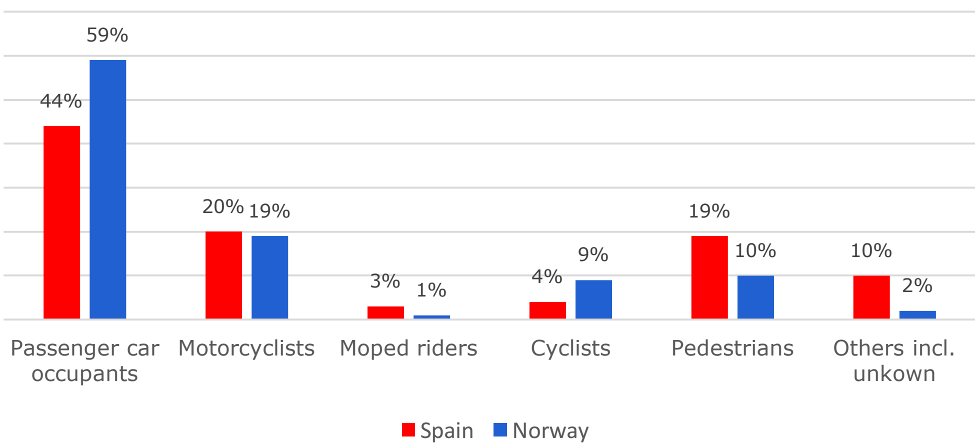


Figure 4.11: Road fatalities by road user group in Spain and Norway in 2017 (IRTAD, 2018)

In 2017, 3,9 and 2,0 traffic deaths per 100 000 inhabitants were registered in Spain and Norway, respectively. When accounting road fatalities by road user group in 2017, cyclists account for 4 % in Spain and 9 % in Norway (Figure 4.11.).

In Spain (2016) 1 in 27 fatalities involved a cyclist whereas in Norway (2016) 1 in 12 (IRTAD, 2018). Pubescent (10–18 years) cyclists have a higher risk of being injured in cycling accidents while older cyclists (65+ years) have a higher risk of being killed than other age groups (Von Below, 2016).

Norwegian cyclists rated the safeness sensation while riding in main Norwegian cities (Bergen, Oslo, Stavanger, Trondheim) and around 20 % reported to perceive cycling as a very unsafe activity while only 2-5 % said they feel very safe in the four cities (Bjørnson et al., 2018). According to the Cycling Barometer (GESOP, 2017), there is no significant difference between male and female when rating cycling as a dangerous activity (23 %) (Figure 4.13.). (et al., 2018)

4.5.1 Segregated traffic

Cyclists often find themselves sharing space with motorized vehicles, other cyclists and/or non-motorized road users on sidewalks (Paschalidis, et al., 2016). Miscommunication and incorrect assumptions about each other's reactions are one of the main reason for collision between cars and bicycles (Chaurand and Delhomme, 2013). A good design of separated facilities reduces the number of non-desirable encounters, which is fundamental to increase the use of bicycle for both recreational and commuting travel (Landis et al., 2003).

On separated facilities, cyclists are physically separated from motor vehicles by barriers while on-street facilities involve bicycles travelling in the same road cross-section with motor automobiles only separated by lane markings (Li et al., 2011). Bicyclists feel more comfortable while riding on protected bike lanes (Foster et al., 2015).

Large research regarding transport safety reveals that separated bicycle roadways can encourage bicycling and reduce accidents compared to on-street bicycle facilities. Many findings indicate that, in general, bicyclists feel safer when separated from motor vehicles and pedestrians (Dill et al., 2012; Lawson et al., 2013; Foster et al., 2017; Wang et al., 2018). Women specifically seem to be even more opposed than men when considering sharing the road with vehicular traffic (Byrnes et al., 1999; Harris et al, 2006) thus female cyclists prefer off-road paths separated from traffic (Garrard et al. 2006; Grudgings et al., 2018) and thus, they ride less regularly when biking on roads is the only option.

SPAIN

According to the Cycling Barometer (2017), Spanish men (19 %) also seem to be more concerned about the traffic than women (15 %) (Figure 4.12.). However, when asked if they ride on-street facilities sharing space with cars, 36 % of women answered they never did, whereas 19 % of men did (GESOP, 2017).

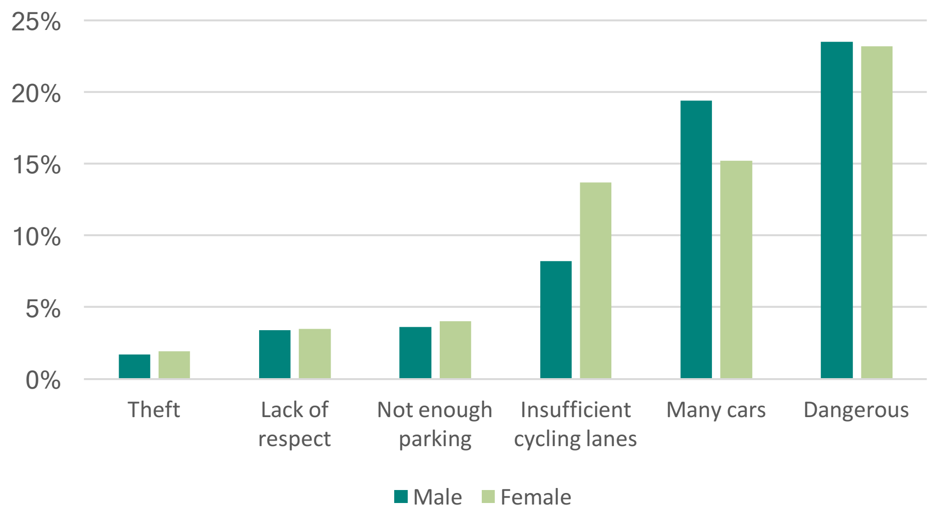


Figure 4.12: Reasons for not cycling in Spain (GESOP, 2017)

NORWAY

According to GESOP (2017), "many cars" was believed to be the most problematic factor for both genders when asked about the most important reasons for not cycling in Norway (Figure 4.13.). However, contrary to previous research and according to the same survey, Norwegian males (55 %) tend to be more worried than women (49%).

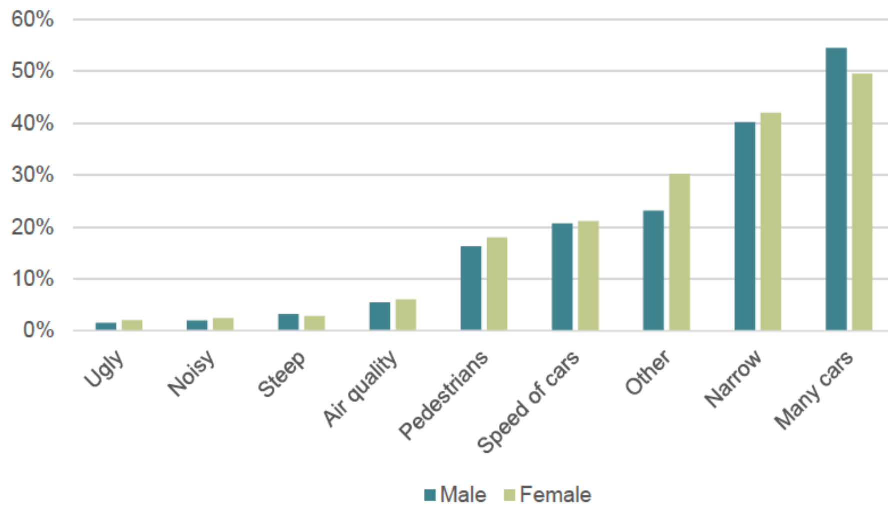


Figure 4.13: Reasons for not cycling in Norway (Bjørnson et al., 2018)

However, regarding exposure of cyclists when sharing infrastructure with motor vehicles, several studies have shown an increase in bicyclist safety when cycling share increases (Jacobsen, 2003). This phenomenon is known in literature as safety in numbers (SiN). SiN is used to explain the non-linear statistical relationship between an increase in number of pedestrians or bicyclists and a less than proportional increase in the number of injuries involving the same road users and motor vehicles (Elvik, 2009; Geyer et al., 2006; Jacobsen, 2003).

4.5.2 Car drivers' attitude towards cyclists

Cyclists' fear of sharing facilities with motor vehicles leads to a lessening in the number of cyclists on the roads (RAC, 2015). However, this fear is not only related to safety issues. It is also associated with stress experienced by bicycle users when encountering other road users (Aldred, 2013; Kaplan and Prato, 2016) or due to usual harassment towards cyclists (Heesch et al., 2011).

Findings show that many car drivers have negative attitudes towards cyclists (Basford et al., 2002; Johnson et al., 2014; Thørrisen, 2013) specifically because many road users tend to have a sense of supremacy (Nixon, 2014; Kaplan and Prato, 2016). Nixon (2014) suggests that people that only travel by car behave more aggressively towards other road users than those who also use other means of transport (e.g., cycling and walking). Further studies show that a large proportion of drivers do not believe that cyclists should be on the roads (Rissel et al., 2002). On the other hand, it is not clear if anger expression is lower among cyclists than car drivers (Oehl et al., 2019). Ellison-Potter et al. (2001) suggested that lower levels of anger expression among cyclists may be explained by cyclists being less "anonymous" that is more exposed compared to drivers.

Cyclists perceive that the most common form of harassment by car drivers is intentionaly driving too close to them (Heesch et al., 2011; Heesch et al., 2017). In response, minimum passing distance (MPD) laws have been introduced. In Spain, drivers are requiered to leave at least 1 m of MPD when passing in lower speed zones and 1,5 m in higher speed zones.

Several studies show that drivers leave greater passing distances when there are more and wider lanes (Apasnore et al., 2017; Mehta et al., 2015). Cars seem to leave more space between them and the cyclists than vans, trucks or buses (Stewart and McHale, 2014). However, the presence of oncoming cars is associated with shorter MPD (Mehta et al., 2015).

Gender factors seem to influence the passing distance as well. Previous findings have demonstrated that drivers leave greater MPD when passing cyclists who appear to be women (Walker, 2007; Sando et al., 2011; Chuang et al. 2013). Yet, a more recent study (Haworth, 2018) did not find any relation between passing distance and gender of the cyclist. It is suggested in the latter that differences in findings may be explained by the MPD road rule being put into effect.

4.5.3 Use of helmet

Bicycle helmets reduce head, brain and face injuries (González Pacheco et al., 2014; Olivier et al., 2017). Stil, the bicycle helmet is not commonly used in many countries. Klein et al. (2005) studied the helmet use in 26 countries concluding that helmet use did not even reach 50% in any country (Klein et al., 2005). Therefore, the main problem in bicycle helmet usage is that it has a low rate in many countries (Lajunen, 2015).

Findings suggest that there is a relationship between age and the willingness to use a bicycle helmet in such a way that younger children are more likely to wear them than teenagers (Dellinger et al., 2010; Klein et al., 2005). Helmet use is mandatory among adolescents in Spain (Molina-García et al., 2016) whereas in Norway, cyclists are not obliged to wear a helmet (ISMO, 2017). Older riders are, on average, at slower speed than younger riders and they might perceive unnecesary to use a helmet on a regular basis (Scaramuzza et al., 2015; Schleinitz et al., 2017).

Moreover, trip length seems to be correlated to helmet use (Kakefuda et al., 2009) as, on average, cyclists do not wear a helmet for short trips (Lajunen, 2016; Teschke et al., 2012). Bicyclists are more likely to use a helmet for longer and recreational trips rather than for commuting or for short errand-trips (Teschke et al., 2012).

The type of user also appears to influence helmet usage since non-cyclists generally dislike helmets more than regular cyclists (Emond et al., 2009).

Helmet usage is also related to the gender of the cyclist (Fischer et al., 2012) because women normally ride slower than men and their trips are shorter (Petzoldt et al., 2017; Scaramuzza et al., 2015), which may lead to less women willing to use a bicycle helmet.

SPAIN

In Spain, 59,5 % of bicycle users wears a bicycle helmet always or almost always (GESOP, 2017). In the same study, 65 % of male cyclists and 50 % of female cyclists reported to do so.

NORWAY

In a study conducted in Eastern Norway in 2008, 35% females and 41% males of passing bicyclists above 17 years of age used a helmet (Muskaug et al., 2009). However, according to Bjørnson et al. (2018) the helmet usage share among Norwegian cyclists is 71 %.

4.6 Cycling infrastructure design

Previous research found a positive association between active mode use and cycling infrastructure (Heinen et al., 2010; Fraser and Lock, 2010).

A bicycle lane is a lane in the roadway which is intended for public bicycle traffic. Bicycle symbols are drawn on the pavement to distinguish bike lanes and arrows to specify driving direction (Statens Vegvesen, 2013). The cycling infrastructure is known to be a key factor to promote cycling (Crane et al., 2017; Nielsen et al., 2018). Thus, some inequalities in cycling gender rates are explained by differences regarding the perception of the infrastructure's attractiveness.

As previously mentioned, safety risk influences women's choice of bicycling. Many studies revealed that perception of safety is highly and positively dependent on the existence of bicycle facilities (Parkin et al., 2010) and its characteristics, such as lane width, lightning and bicycle parking.

4.6.1 Priority at intersections

An intersection is a complex area where many interactions can occur between bicyclists, motor-vehicles and pedestrians (Wang and Nihan, 2004; Strauss et al., 2013). Actually, most accidents involving cyclists happen in intersections (Statens Vegvesen, 2013; Dozza et al., 2014). However, it is difficult to avoid mixed traffic situations due to frequent discontinuity of on-street bicycle facilities and limited right of way situations, especially in urban areas.

In order to reduce the risk of accidents and the severity of the accidents at the intersections it is important that the speed level is low and that lighting and visibility are good (Statens Vegvesen, 2013). A well-planned intersection must have clear signalization, sufficient visibility so vehicles or pedestrians entering the intersection can react, if necessary (DGT, 2000). In this sense, both countries try to satisfy the same priorities when designing a bicycle's lane intersection.

Several studies have revealed that adequate infrastructure investments, such as bicycle crossing markings, bicycle boxes and traffic calming measures, may significantly improve the bicyclists' safety perceptions at intersections (Wang et al., 2018).

4.6.1.1 Crossing markings

In general, bicycle lanes are not marked up by crossings if cyclists in the bicycle lane make right-handed movements. Cyclists must follow traffic signals for other traffic when cycling paths cross streets with mixed traffic (DGT, 2000; Statens Vegvesen, 2013). According to the Spanish design guidelines (DGT, 2000), crossing marks along both sides of the bicycle paths are the most common measure adopted when cyclists have to cross an intersection (Figure 4.14b). According to the Norwegian design guidelines (Statens Vegvesen, 2013) bicycle lanes are marked through intersections when the cycle path is regulated so that driving on a crossing road should give priority to cyclists in the bicycle lane (Figure 4.14a).

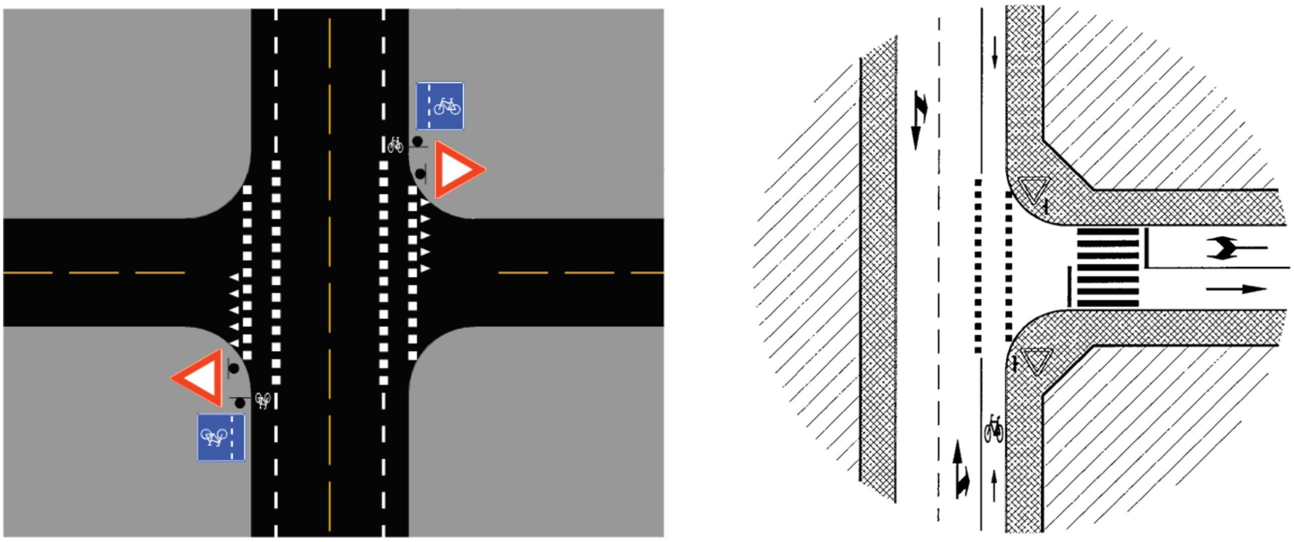


Figure 4.14: Design guidelines for marked bicycle lanes in intersections in Norway and Spain (Statens Vegvesen, 2013, 2014; DGT, 2000)

In general, the presence of intersection crossing markings is positively associated with bicycling comfort levels (Mekuria et al., 2012).

4.6.1.2 Bicycle boxes

The bicycle boxes are a good recommendation implemented in the crossings of many European cities. They mark waiting areas in the intersection in front of the car's stop line (Statens Vegvesen, 2013). The bicycle box enhances the accessibility of the cyclists and makes them more visible to others road users, and can be used in signal-regulated crosses for left-handed or straight-forward cyclists (Statens Vegvesen, 2013). They reduce the number of accidents between the vehicles that turn to the right and the cyclists that cross the intersection in a straight line. (DGT, 2000). The presence of bicycle boxes can significantly increase all types of bicyclists’ safety perceptions at intersections (Wang et al., 2018). Findings show that the presence of bike boxes leads to a reduction in bicycle–motor-vehicle conflicts (Dill et al., 2012).

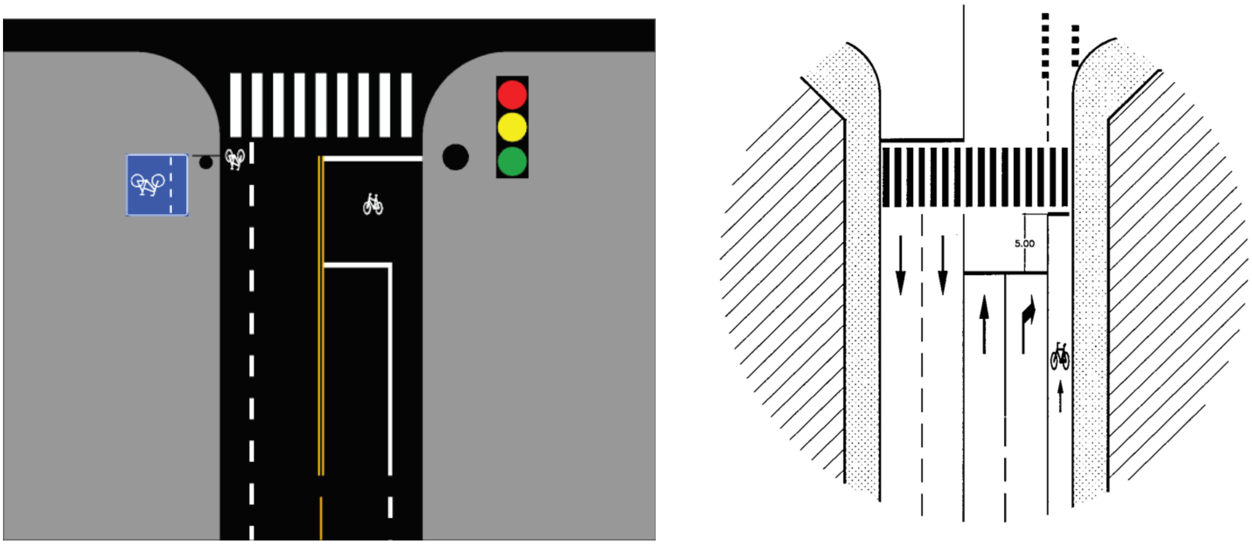


Figure 4.15: Design guidelines for bicycle boxes in intersections in Norway and Spain (Statens Vegvesen, 2013; DGT, 2000)

According to the Spanish design guidelines (DGT, 2000), the length of bicycle boxes should be 5 m (Figure 4.15b). This number is based on findings of various Swedish and Danish studies that showed that cyclists are more visible to heavy vehicles when they are located more than 4 m in front of them. According to the Norwegian design guidelines (Statens Vegvesen, 2013), the width of the box is bicycle lane width plus lane width, while length should be 4-6 m (Figure 4.15a) the bike box is marked with a bicycle symbol in the roadway.

4.6.1.3 Roundabouts

Both, regular and potential, bicyclists feel stressed when riding through complicated intersections (more than 4 ways) (Wang et al., 2018). Past studies have shown that roundabouts may be a good solution when having an intersection of more than 4 ways as they enhance bicyclists’ safety perceptions by reducing the number of potential conflict points between bicyclists and automobiles (Møller and Hels, 2008; Wegman et al., 2012; Marshall, 2018; Wang and Akar, 2018).

According to the Spanish design guidelines (DGT, 2000), separated bicycle lanes are mandatory when any of the roads that access the roundabout is equipped with segregated bike lane (Figure 4.16b). The bike lane must be unidirectional and the priority exiting the roundabout is for cars. On the contrary, according to the Norwegian design guidelines (Statens Vegvesen, 2013), there should be no dedicated bicycle lane through roundabouts. On bicycle routes with bicycle lanes, the solution with mixed traffic in the roundabout is to have only one path as cycling is easier to perform when there is only one lane (Figure 4.16a).

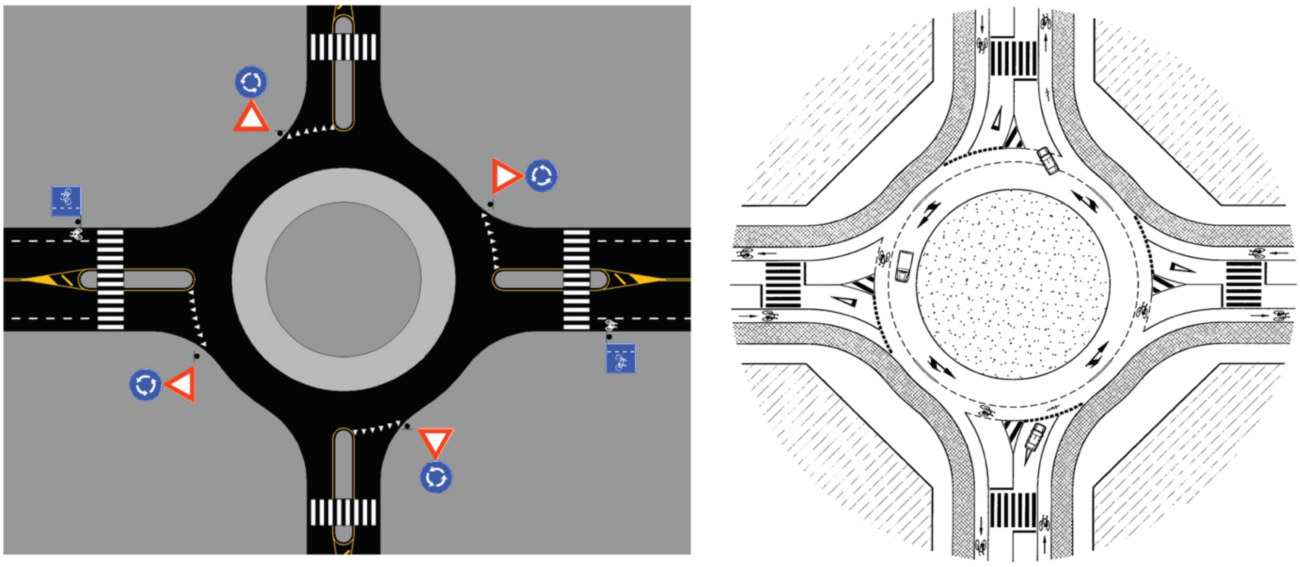


Figure 4.16: Design guidelines for bicycle lanes in roundabouts in Norway and Spain (Statens Vegvesen, 2013; DGT, 2000)

4.6.2 Width

Studies revealed that the width of a bicycle path and, consequently, the bicycle traffic volume are significant variables positively related to the comfort as wider lanes offer more space for cycling (Landis et al., 1997; Li et al., 2012). Feeling comfortable using bicycle facilities is one of the strongest positive influences on women's bicycle use (Emond et al., 2009).

According to the Spanish design guidelines (DGT, 2000), for normal speeds (15-30 km/h), 1 m of width is considered enough to be occupied by a cyclist in motion. However, for safety reasons, it is recommended to give a clearance of 0,25 m on both sides when designing a bicycle lane. Resulting a total required width of 1,50 m in unidirectional bicycle lanes. If the traffic is very intense, it will be necessary to leave a wider safety distance along the sides of the lane and so the normal width will be 2 m (Figure 4.17.). Guidelines in Norway (Statens Vegvesen, 2013), have very similar recommendations. In order to accommodate bicycle lanes on both sides, the road must have a width of at least 5,5 m. Bicycle lanes can have a width down to 1,25 m. But in case of heavy traffic or normal speed higher than 50 km/h, the width should be 1,55 m. The specified clearance is 0,25 m (Figure 4.18.).

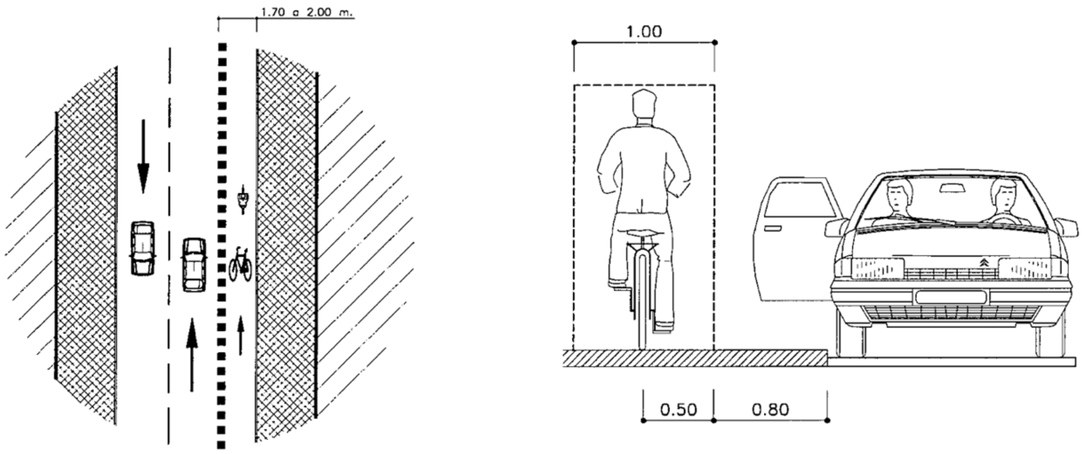
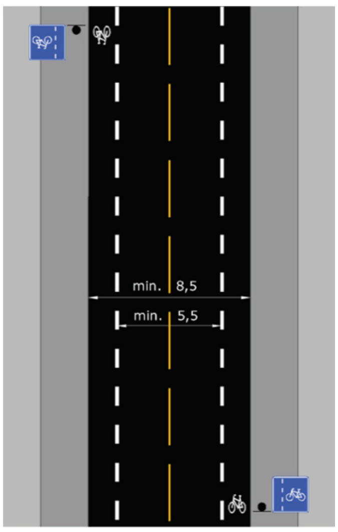
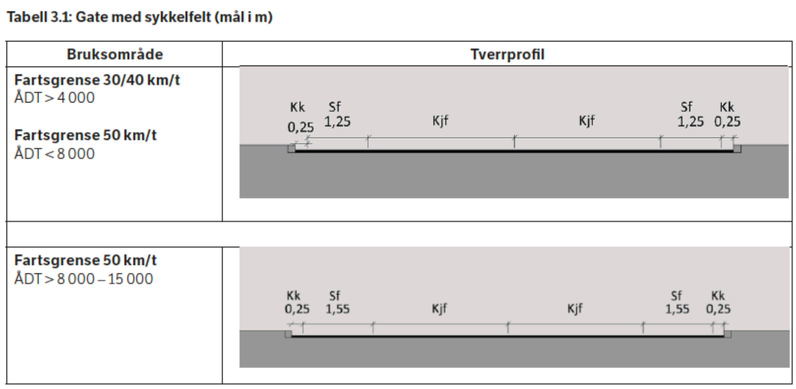


Figure 4.17: Design guidelines dimensions for bicycle lanes (in meters) in Spain (DGT, 2000)




Tabell 3.1: Gate med sykkelfelt (mål i m)

Bruksområde	Tverrprofil
Fartsgrense 30/40 km/t ÅDT > 4 000 Fartsgrense 50 km/t ÅDT < 8 000	Kk 0,25 Sf 1,25 Kjf Kjf Sf 1,25 Kk 0,25
Fartsgrense 50 km/t ÅDT > 8 000 – 15 000	Kk 0,25 Sf 1,55 Kjf Kjf Sf 1,55 Kk 0,25

Figure 4.18: Design guidelines dimensions for bicycle lanes (in meters) in Norway (Statens Vegvesen, 2013)

4.6.3 Lightning

Perceptions of safety among women drop rapidly when it is dark, possibly due to concerns about both traffic and personal safety (Inclusive city cycling, 2017). Consequently, females who work at night may modify their decisions towards commute cycling to work.

SPAIN

When designing cycling paths in Spain, the cycle path will have the same level of lighting as the road when it goes through urban areas. In interurban areas, the need for lighting should be studied depending on the characteristics of each bicycle path. Visibility is very important at intersections. Thus, it is recommended to illuminate the cycle path around 50 meters before the crossing, so that drivers can see cyclists before crossing an intersection (Generalitat, 2008).

NORWAY

As far as studies revealed, there are no guidelines regarding lightning in cycling paths in Norway.

4.6.4 Bicycle parking

Bicycle parking is a natural part of the ending for bicycle traffic. Thus, facilities for bicycle parking can contribute to more bikes to and from daily chores.

Bicycle parking spaces positively influence the use of bicycles (Pikora et al., 2003; Pucher, et al., 2010; Sallis). Previous research has shown the preference of women to have secure bicycle parking stations, perhaps due to women's greater risk aversion (Garrard et al., 2008). Parking infrastructures and other services for avoiding theft seem to be the main demand of cyclists for further developments of bike mobility (Marqués et al., 2014).

Both Norwegian (Statens Vegvesen, 2013) and Spanish (DGT, 2000) design guidelines point out that the main recommendations that should be taken into account when designing bicycle parking. They are:

· Security: prevention against theft or acts of vandalism.

· Versatility: parking lots should be able to accommodate any type and dimension of bicycles. Bicycle parking should offer charging points for electric bikes.

· Accessibility: parking places should be located near to people's destination.

· Stability: bicycle parking should guarantee the fastening without damaging the bicycle, to counteract the inappropriate use they can make people who drive bicycles

· Comfort: users should be able to hold the bicycle quickly but also, the bicycle racks should be placed in such a way that do not create obstacles in pedestrian paths. The bike racks should be positioned so that the bikes are not too close to each other and so that it is sufficient space to manoeuvre the bikes in and out of the racks.

· Climate protection: it is necessary to consider sun and rain protection. Covering is recommended to have sufficient projection outside the parking area to avoid rain and snow on parked bikes.

It is also necessary to bear in mind that bicycle parking should be located at strategic points such as rail and bus stations, schools, kindergartens, shopping centres, sport and leisure facilities and workplaces. The number bicycle places should be dimensioned according to the destination buildings (Statens Vegvesen, 2013; DGT, 2000).

SPAIN

For bicycle parking to be useful, it should be placed within a maximum radius of 50 m (30 seconds walking) around the points of interest. Otherwise, users resort to spontaneous parking such as trees, street furniture or traffic signs that are in the vicinity of the destination (IDAE, 2005).

NORWAY

When planning bicycle parking, ideally, bike parking spots should be as close to the destination as possible while being close to the bicycle lane. According to the Norwegian guidelines (Statens Vegvesen, 2013), wherever possible, cyclist should be able to find the nearest bicycle parking within a walking distance of less than 25 m.

5 Planning and conducting the survey

In this chapter, the planning and conducting of the survey will be displayed.

This section is divided into three subchapters. In the first one, the places where data has been collected and the ways of recruiting data will be presented. Following, the pilot survey and the modifications carried out after performing it will be described. And finally, the questionnaire itself will be presented, explaining why and how the questions have been formulated.

5.1 Study recruitment

Since the aim of this study is to discover differences in cycling behaviour in Spain, the survey was distributed among various age groups and locations. Thus, the survey was conducted online and on paper in order to reach as many different people of different ages and localities as possible.

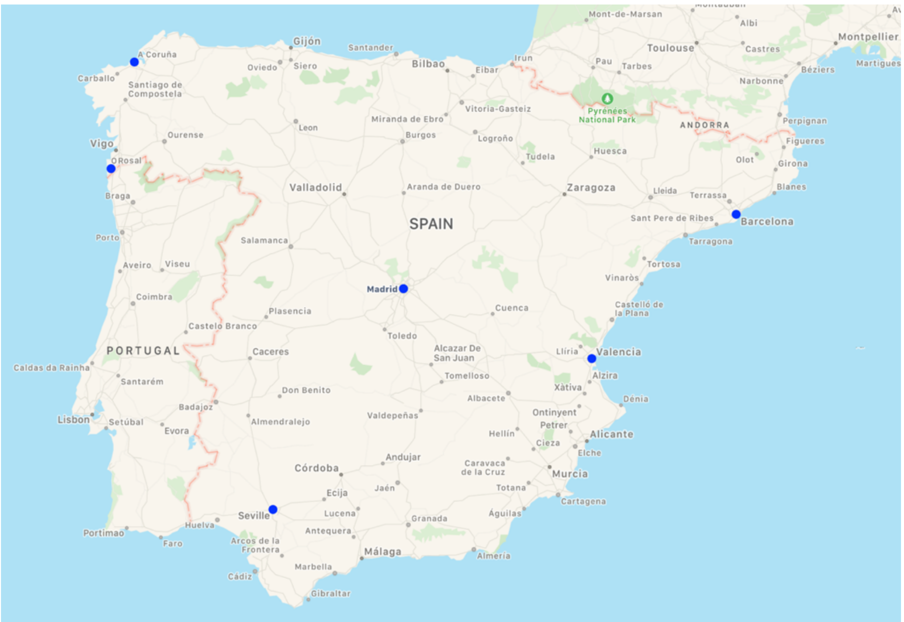


Figure 5.1: Cities surveyed represented in a map of Spain

A link of the survey was shared via e-mail to students of two Spanish universities in two different cities (A Coruña and Barcelona) and users of a bicycle shop in a small town (O Rosal), in particular. Broadly speaking, the survey was posted on social media, with the main goal to reach a wide range of individuals with different occupations and various ages. Moreover, bicycle associations from Madrid, Barcelona, Seville and Valencia shared the link via the social media platform *Twitter*. All the mentioned cities are highlighted on Figure 5.1.

In order to reach adolescents at young ages and elderly people who, in general, do not make use of the Internet platform on a regular basis, the questionnaires were distributed in written form so they could be filled out on paper. For the kids, the survey was delivered in a school and a high school's classrooms located in O Rosal where, pupils were aged 14-15 and 16-17, respectively. There is a response rate of 100% among the high school students as all of them completed the survey during the class. On the contrary, students at the age of 14-15 were asked to fill out the survey at home, so not all of them submited the survey. For the elderly people, the questionnaires were handed out in a park where participants were 55 years or older. All the participants were assured anonymity and confidentiality.

With respect to the layout of the questionnaire, there were no major changes. Just some small changes regarding the wording have been done in order to facilitate an easier understanding. Thus, since both questionnaires (adults and children's forms) are essentially identical, all answers can be compared directly.

At the beginning of the questionnaire a short introduction including the main purpose of the study and approximate duration was presented in order to make participants familiar with the survey.

The online survey was active for a 3-week period from 27th March to 17th April, 2019. However, before the data collection took place, a pilot survey was conducted in order to remove potential problems that could occur during the filling out process.

5.2 Pilot survey

It is recommended to first perform a pilot survey before embarking on the main survey (dell'Olio et al., 2018, p. 49-61). The purpose of a pilot study is that friends and acquaintances give feedback about the survey in such wise that can be improved before being sent out for data capture (Kothari, 2014). Surveys reach many different people who can perceive the questions differently, thus corrections to get better understanding are needed.

A pilot survey was conducted among 20 people of different age, gender and social status. All of them were asked to give some feedback right after they finished answering the questionnaire. Their comments were taken into account and some aspects were modified:

· Younger participants could not answer all the questions because they did not understand them. They thought wording was too specialized. Thus, questions were adjusted so all public (kids, in particular) could comprehend the questions.

· Some of the respondents thought the information given at the beginning of the survey was too long and people would lose interest. Therefore, it was shortened for respondents to have a quick idea of the survey's aim.

· Furthermore, some of them claimed the survey was too long. Therefore, the questionnaire was overworked and shortened in terms of amount of questions, as some questions were considered to be very similar.

· Others pointed out that the drawings were a bit unclear. Thus, it was decided to write a brief explanation under each drawing.

The pilot survey also helped to correct typos and errors due to the translation of the questions.

5.3 Questionnaire

The questionnaire was first written in English, then translated to Spanish, and then translated back to English to verify its accuracy. A copy of the survey is presented in the appendix A at the end of this paper.

5.3.1 Individual characteristics

Classification questions, which are usually related to socio-economic and demographic characteristics (Richardson et al., 1995, p. 165), have been used in order to categorize the respondents. In the planned survey, topics such as gender, age, current occupation and municipality have been inquired.

Given the formulated questions, the allocation of respondents into different categories depends on the way in which they answer. Respondents have been placed into groups on the basis of un-orderable classifications e.g. being female/male/other or living in a village/town/city/metropolis.

The order of the questions within a survey is an important aspect to be considered. According to the literature, the end of the questionnaire fits best for personal questions as some individuals may refuse to participate if they consider that too many personal questions are being asked early in the questionnaire (Richardson et al., 1995, p. 205).

In addition, previous research suggests that individuals who do not own a car are likely to bicycle more per week (Lusk et al., 2014). Thus, a question regarding the participants' ownership of different vehicles has been raised in order to analyse this finding. Respondents could choose from given answer (car, city bicycle, road bicycle or motorcycle) or add another one.

Dill et al. (2014) studies confirmed that cognitive elements (such as ''I like riding a bike") play an important role in explaining cycling participation. Thus, two questions concerning the ability to ride a bike and the delightfulness of riding have been brought up, in order to know more about the individuals' likings. These two questions are very specific. Therefore, the only possible answers given have been either yes or no.

5.3.2 Cycling experience

With the purpose of being able to analyse the gender differences in cycling behaviour, factual questions, where the participants are asked to report their general experiences and knowledge (Richardson et al., 1995, p. 167), have been included in the questionnaire.

Childhood and nowadays

According to the literature review, gender inequalities in cycling begin early in childhood. In order to examine this finding, questions about the frequency of bicycle riding when participants were younger and how often they cycle now have been introduced in the survey.

In the case of bicycle usage at early years, the purpose of the trips has not been taken into account. On the contrary, current cycling behaviour of participants has been divided into four categories depending on their purposes: transport, exercise, leisure and other daily movements.

The possible given answers have been the same ones for childhood and current bicycle use. Being these options: 1=Never/Almost never; 2=1 to 3 days a month; 3=1 day a week; 4=2 to 4 days a week; 5=More than 4 days a week. Participants could also choose "I do not know/no answer" if they did not have a clear answer.

Wishfulness to ride more

In order to know more about the respondents' preferences, their desire to change their routines has been questioned as well.

In this case, the given responses have been 1=No; 2=No, I already ride enough; 3=Yes, a bit more; 4=Yes, a lot more; 5=I do not know/No answer.

5.3.3 Reasons for cycling or not

The ultimate goal of the questionnaire is to identify which factors influence Spanish people the most when deciding whether to cycle or not. Consequently, opinion and attitude questions (Richardson et al., 1995, p. 168) in view of the motivations and barriers for bicycling and not bicycling have been included in the questionnaire.

The participants have been required to select from several possible reasons, which result of previous literature review. In this section, respondents could choose one of the listed options, more than one or include a new one by writing a comment under "other".

5.3.4 Factors influencing the choice of cycling

Aiming to find out why some people choose to ride and others do not, opinion questions regarding different positive (e.g. green areas or good quality of infrastructures) and negative (e.g. bad weather or hilly topography) factors that may influence the choice of cyling have been asked in the survey.

In this section, Likert scale answers have been given. Meaning, the mentioned factors have been rated by the respondents. A five-point dimension is recommended (Richardson et al., 1995, p. 176). Thus, the possible answers were: not at all, very little, somewhat, much and very much.

It was mandatory for all the participants to respond these questions. However, those who were not sure or did not know what to answer have been able to choose "I do not know/no answer".

5.3.5 Improvements needed

Many of the study reviews showed that perception of safety depends on the existence of bicycle facilities and its characteristics, such as lane width, lightning and bicycle parking. However, no previous research has been found with respect to how the design of the infrastructures affects gender decision of cycling or not.

Hence, participants have been asked to state their opinion on a given list of impromments needed on route and at destinations. Again, a Likert scale of answers has been given so the suggested upgrades could be rated from not at all important to very much important.

5.3.6 Comfort and safety concerns

According to the literature review, preferences regarding cycling infrastructures vary among gender. Some cyclists feel more comfortable riding in separated facilities while others do not consider sharing the road space with motor vehicles and pedestrians as a dangerous situation.

Opinion questions regarding comfortability and safety concerns in different scenarios have been asked aiming to know what the most preferable cycling lanes type are and what the biggest worries of cyclists when riding are. The issues included in these two questions have been decided based on previous literature review.

For the comfortability, a Likert scale of answers have been given being 1= Uncomfortable; 2= Uncomfortable but would ride anyways; 3= Comfortable; 4= Very comfortable; 5= No answer. For the concerns when riding a bicycle, the answers given were based on a five-point Likert scale from not at all concerned to very much concerned.

In addition, intersections are often seen as problematic because they are complex areas where many interactions between cyclists, motor vehicles and pedestrians can occur. Questions including different signalization options in different scenarios have been asked aiming to know what options are considered to be the safest by the Spanish users.

In this case, the Likert scale was a five-point dimension from not at all safe to very much safe.

5.3.7 Respondents’ opinion

It is often suggested to place an open-ended question at the end of every questionnaire question in which the respondents can write their general comments if they want to (Richardson et al., 1995, p. 187).

Thus, in the final part of this questionnaire, respondents have been asked to state their personal opinion or give recommendations regarding the survey itself or gender differences in cycling behaviour, in general.

6 Results

In this chapter, the findings from the survey will be presented.

The chapter is divided into three sections. First, a brief explanation regarding collection of data and general information about respondents' characteristics will be presented. Secondly, a more thorough analysis of the entire sample will be carried out. Specific aspects such as usage of the bicycle, factors influencing the choice of cycling, improvements needed and issues related to comfortability of cyclists will be studied. Lastly, a summary of the respondent's opinions will be presented and divided by categories.

6.1 Study sample

6.1.1 Collection of responses

In total, 585 people responded the online form whereas 68 did it via printed questionnaire and submitted their answers in written form.

Since the survey was posted online on social media platforms, it is not possible to know how many people have been reached and therefore, the response rate is unknown.

In the written form, a total of 67 out of 82 people who were reached, responded the questionnaire. That is, a response rate of 81,7% (Table 6.1.). Nine people asked in the park refused to answer and six pupils from the mentioned school forgot the survey at home, so their answers were not computed.

Place	Delivered	Submitted	Response rate
High school (16-17 years old)	20	20	100%
School (14-15 years old)	22	16	72,7%
Park (58 or older)	40	31	77,5%
Total	82	67	81,7%

Table 6.1: Number of written questionnaires distributed and collected

6.1.2 Participants’ characteristics

The final dataset contains 653 individuals from all over Spain, of whom 53,1% are women, 45,7% men and 1,2% preferred not to mention their gender. The breakdown of their gender, age, current occupation, municipality size and ownership characteristics is described in Table 6.2. In addition, general and gendered riding knowledge and bicycle enjoyment ratios are presented in Table 6.3.

The distribution of individuals over age shows that the age range of the participants is more or less equally spread, with the exception of people younger than 15 (Figure 6.1.). Due to underrepresentation, it was decided to include younger than 15 into the 15-19 group naming them “younger than 20”.

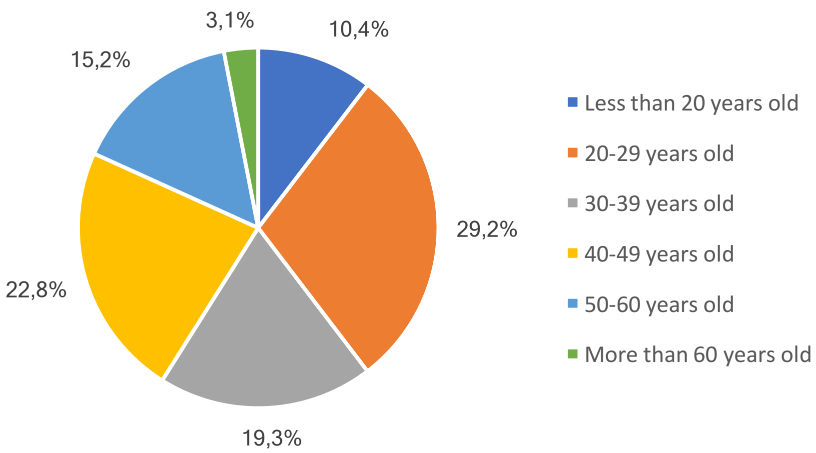


Figure 6.1: Age distribution

About the place of residence, the municipality distribution is, again, more or less evenly spread out (Table 6.2.). Since Spain is quite a big country with large differences between the metropolis and the villages, it was considered essential to gather data from municipalities of all sizes.

Most individuals in the sample own or have access to a car while bicycle ownership/accessibility share is 63,0% for city bikes and 35,9% for road/mountain bikes. Some of the respondents have or can use motorcycles or kick scooters and few of them are able to use other means of transportation (such as taxi, roller skates, horse…) (Table 6.2.).

		Frequency	Percentage
Gender	Female	347	53,1 %
	Male	298	45,6 %
	No answer	8	1,2 %
Age	<15	10	1,5 %
	15-19	58	8,9 %
	20-24	83	12,7 %
	25-29	108	16,5 %
	30-34	48	7,4 %
	35-39	78	11,9 %
	40-49	149	22,8 %
	50-60	99	15,2 %
	>60	20	3,1 %
Current occupation	Employed	434	66,5 %
	Student	181	27,7 %
	Housekeeping	12	1,8 %
	Not working	13	2,0 %
	Retired	13	2,0 %
Municipality	< 10 000 inhab	131	20,1 %
	10 to 100 000 inhab	188	28,9 %
	100 to 500 000 inhab	204	31,3 %
	>500 000 inhab	128	19,7 %
Ownership	Car	526	80,7%
	City bicycle	411	62,9%
	Road/Mountain bicycle	235	36,0%
	Motorcycle/Kick scooter	81	12,4%
	Others (taxi, roller skates, horse…)	18	2,8%

Table 6.2: Descriptive summary of respondents' characteristics

The gender differences with respect to ownership/accessibility to different vehicles are presented in Figure 6.2. Motorcycle/kick scooter followed by road/mountain bicycle account for the largest gender dissimilarities. However, the differences are little when considering the car and almost non-existent for city bicycles.

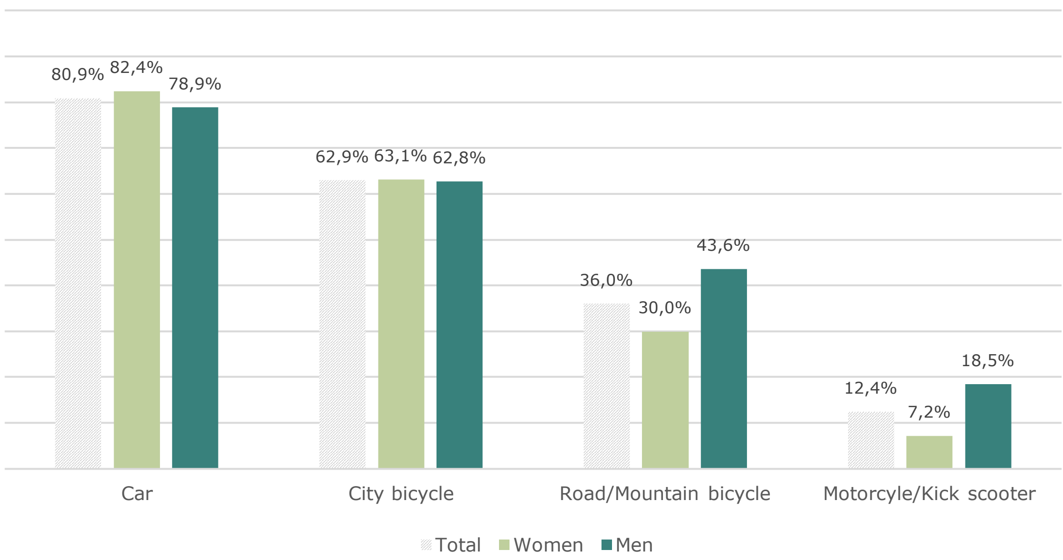


Figure 6.2: Ownership/accessibility to different vehicles by gender

As presented in Table 6.3., almost all of the respondents can ride a bicycle (98,3% of all women, 99,3% of all men). Contrary to what has been mentioned in section 4.1.4, the percentage of female who knows how to cycle is not very different from the percentage of male.

The majority of the participants like cycling (90,2%). However, there is a notable variation by gender among the ones who do not like riding a bicycle (14,7% of all females, 3,7% of all males) (Table 6.3.).

		Female	Male	Total
Able to ride	Yes	98,3%	99,3%	98,8%
	No	1,7%	0,7%	1,2%
Like riding	Yes	85,3%	96,3%	90,2%
	No	14,7%	3,7%	9,6%

Table 6.3: Riding knowledge and bicycle enjoyment percentages by gender

6.2 Analysis

In this section, the data analysis results will be presented, including the gendered differences. The results from the survey have been processed using statistical analysis in the *Excel* program.

6.2.1 Description of variables

Table 6.4. provides an overview of individuals' habits, factors that influence (positively and negatively) participants' decision of cycling, what improvements (on-route and at destination) are needed according to the respondents, comfortability ratings and level of concern regarding several safety issues when cycling reported by all individuals in the dataset.

The answers have been transformed into numeric values in order to average the scores. The scores are presented by gender as well. This way, it is easy to have some knowledge about the participants' opinions and see the differences between female in all the variables. For example, just by taking a quick look at Table 6.4., one can immediatly learn that, on average, male rode more (3,55) than female (3,16) when they were children.

All the variables will be represented in graphs and they will commented in detail in the next sections.

	Variable name	Range	Average score			Description
			Total	Female	Male	
HABITS	Childhood	[1,5]	3,32	3,16	3,55	How often participants rode when they were children on 5-point scale[a]
	Nowadays					
	For transport (to go to workplace/school)	[1,5]	1,91	1,74	2,34	How often participants cycle nowadays on 5-point scale[a]
	For exercise (e.g. training),	[1,5]	1,80	1,61	2,29	
	For leisure (e.g. going to cinema)	[1,5]	1,90	1,82	2,16	
	Other daily movements (e.g. going to supermarket)	[1,5]	1,81	1,69	2,17	
	Future					
	For transport (to go to workplace/school)	[1,4]	2,41	2,31	2,67	Wishfulness to ride more on 4-point scale[b]
	For exercise (e.g. training),	[1,4]	2,74	2,70	2,89	
	For leisure (e.g. going to cinema)	[1,4]	2,76	2,80	2,73	
	Other daily movements (e.g. going to supermarket)	[1,4]	2,30	2,30	2,42	
FACTORS	*Negative*					
	Bad weather	[1,5]	3,76	3,89	3,60	Negative influence in cycling decision on 5-point scale[c]
	Many cars	[1,5]	3,13	3,42	2,74	
	Speed of cars	[1,5]	3,54	3,79	3,24	
	Pollution	[1,5]	2,79	2,90	2,74	
	Hilly topography	[1,5]	3,03	3,36	2,57	
	Health issues	[1,5]	2,51	2,59	2,44	
	Positive					
	Green areas	[1,5]	3,82	4,03	3,60	Positive influence in cycling decision on 5-point scale[c]
	Good quality of infrastructures	[1,5]	4,09	4,24	3,96	
	Fair amount of cycling paths	[1,5]	3,97	4,16	3,77	
	Bad transport network	[1,5]	2,96	3,15	2,74	
	Good lightning	[1,5]	3,42	3,70	3,13	
	Parking at destinations	[1,5]	3,55	3,69	3,42	
IMPROVEMENTS NEEDED	*On-route*					
	Wider paths	[1,5]	3,83	4,03	3,58	Importance of on-route characteristics on 5-point scale[c]
	More pathways	[1,5]	4,12	4,28	3,94	
	Separated paths	[1,5]	4,02	4,24	3,77	
	Traffic calming	[1,5]	3,79	3,92	3,62	
	Good lightning	[1,5]	3,76	3,97	3,51	
	At destination					
	Pathways till destination	[1,5]	3,89	4,12	3,61	Importance of destination improvements on 5-point scale[c]
	Secure parking	[1,5]	3,97	4,08	3,84	
	Showers/changing rooms	[1,5]	2,81	2,76	2,94	
	Lockers	[1,5]	2,90	2,88	2,96	
	Bicycle maps	[1,5]	3,14	3,33	2,89	
COMFORTABILITY	Off-street	[1,4]	2,34	2,20	2,67	Comfort biking in different lane types on 4-point scale[d]
	On-street in a low traffic street	[1,4]	2,68	2,53	2,98	
	On-street in a two-lanes street without cycling lane	[1,4]	1,83	1,65	2,34	
	On-street in a two-lanes street with marking crossings	[1,4]	2,69	2,56	2,95	
	On-street in a two-lanes street with physical barriers	[1,4]	3,29	3,29	3,33	
SAFETY	*Concerns*					
	Hit by a car	[1,5]	3,59	3,76	3,44	Concerns about different factors on 5-point scale[c]
	Hit by another cyclist	[1,5]	1,96	2,12	1,62	
	Mugged/attacked	[1,5]	1,80	2,00	1,42	
	Falling/getting hurt	[1,5]	2,65	2,82	2,43	
	Regarding intersections					
	Crossing markings	[1,5]	3,06	3,04	3,10	Feeling of safeness when crossing different intersection scenarios on 5-point scale[c]
	Clear signalization and lightning	[1,5]	2,74	2,58	3,00	
	Bicycle boxes	[1,5]	3,59	3,63	3,53	

[a] 1= Never/Almost never, 2= 1 to 3 days a month, 3= 1 day a week, 4= 2 to 4 days a week, 5= More than 4 days a week.

[b] 1= No, 2= No, I already ride enough, 3= Yes, a bit more, 4= Yes, a lot more.

[c] 1= Not at all, 2= A bit, 3= Somewhat, 4= Much, 5= Very much.

[d] 1= Uncomfortable, 2= Uncomfortable but would ride anyways, 3= Comfortable, 4= Very comfortable.

Table 6.4: Descriptive summary of the variables

6.2.2 Cycling experience

The usage of the bicycle nowadays and during childhood has been studied to know about the past and current cycling behaviour of the participants. In the case of bicycle usage at early years, the purpose of the trips has not been taken into account.

Moreover, the wish of participants to change their routines has been examined as well.

Childhood

Half of the participants used to ride for any purpose at least 2 days per week when they were children whereas only 11,4 % of them never or almost never cycled (Figure 6.3.).

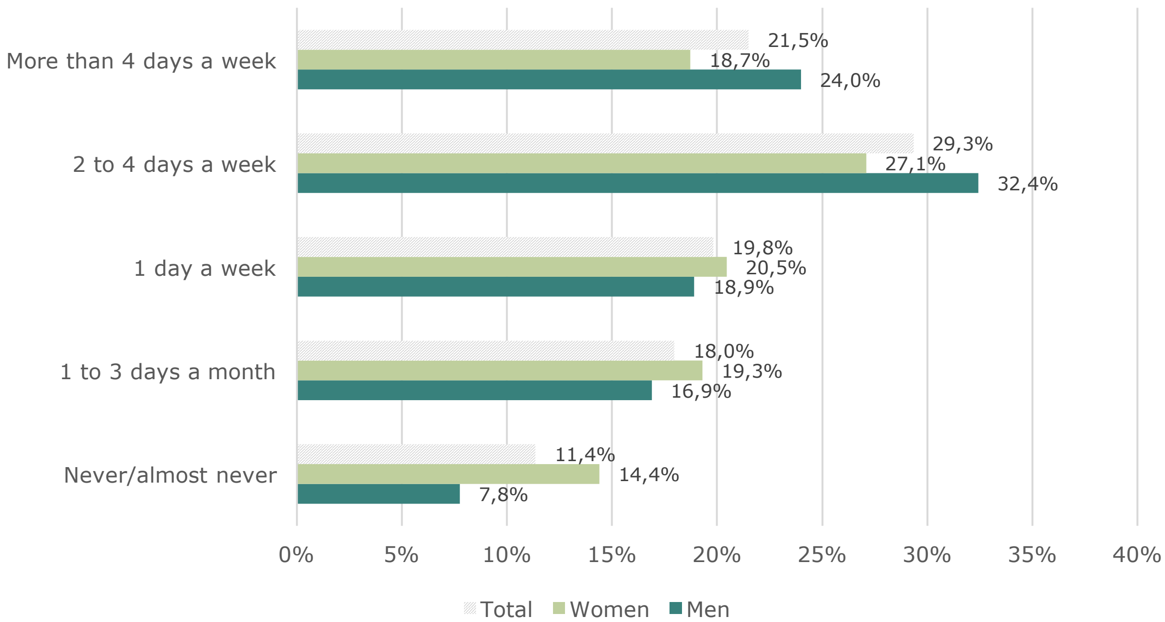


Figure 6.3: Responses to the question "How often did you ride when you were a child?" by gender

Figure 6.3. shows relevant gender differences in bicycle frequency during childhood as the percentage of male who cycled weekly is higher than women. Furthermore, among the few who never/almost never rode, the majority are women. Thus, in general, male rode more and more frequently when they were children than female.

Nowadays

In line with expectations, half or more than half of the population interviewed never or almost never rides their bicycles for any purpose. Figures 6.4. to 6.7. show that frequent bicycling rates are very low and Spanish hardly ever use their bikes more than 4 times a week. Commuting cycling is the only activity participants normally do (14,1%). The highest weekly cycling share is for commuting purposes (24,5%), followed by other daily movements (23,8%), leisure purposes (22,4%) and exercising (20,3%).

In general, women make fewer trips by bicycle for commuting, exercise, leisure and other daily movements. As it can be seen (Figure 6.4. to Figure 6.7.), more female than male reported to never or almost never cycle regardless the purpose.

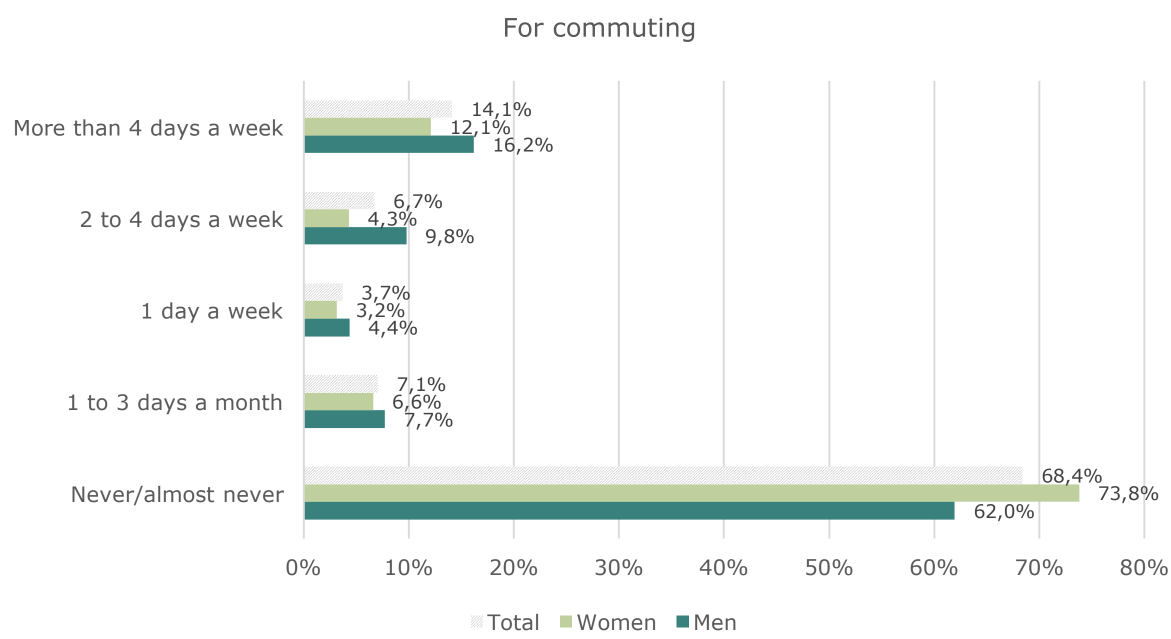


Figure 6.4: Responses to the question "How often do you cycle for commuting purposes?" by gender

Regarding exercise purposes, there is a dissimilarity by gender among participants who never/almost never cycle (60,8% of all female, 44% of all male) and among those who cycle more than 4 days a week (0,6% of all female, 3% of all male). However, the total cycling share of people who ride to do exercise more than 4 days a week is very low (Figure 6.5.).

There are no big gender differences with respect to bicycle users with leisure motivations as the ratio of female and males for all the frequencies is more or less the same (Figure 6.6.).

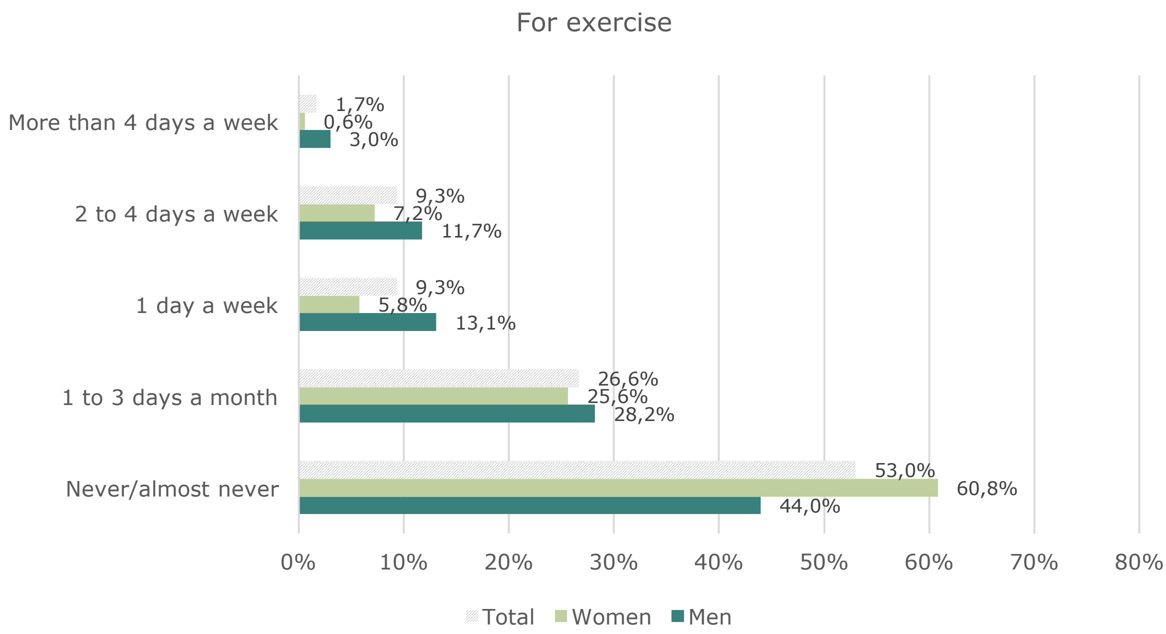


Figure 6.5: Responses to the question "How often do you cycle for exercise purposes?" by gender

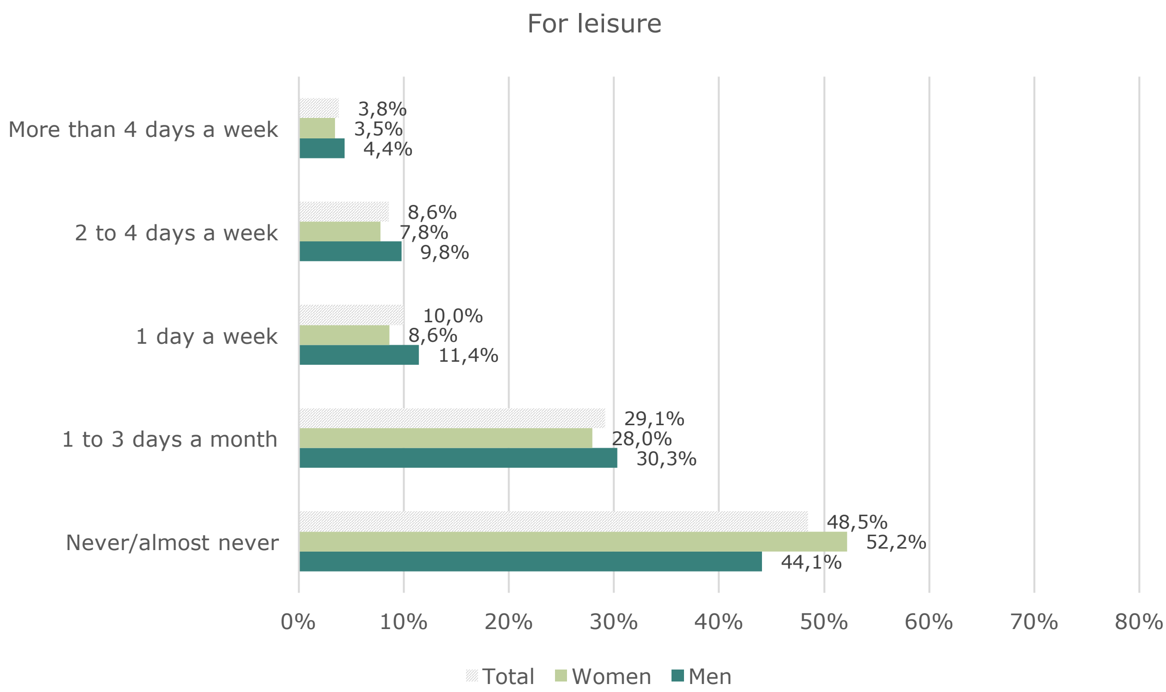


Figure 6.6: Responses to the question "How often do you cycle for leisure purposes?" by gender

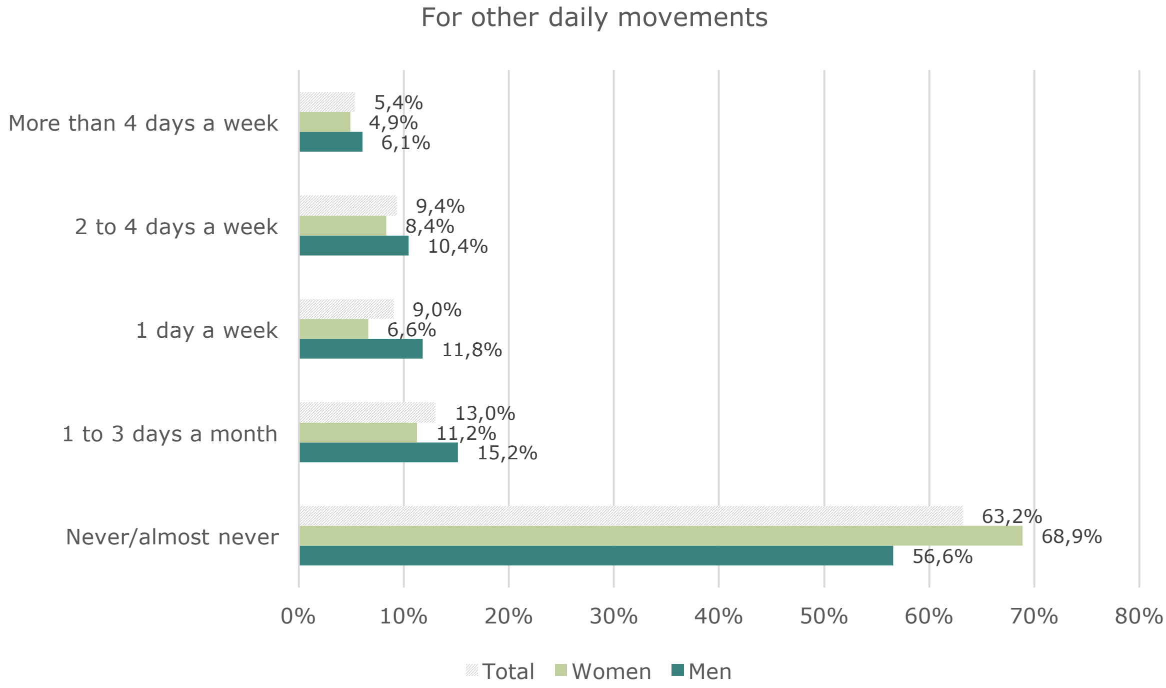


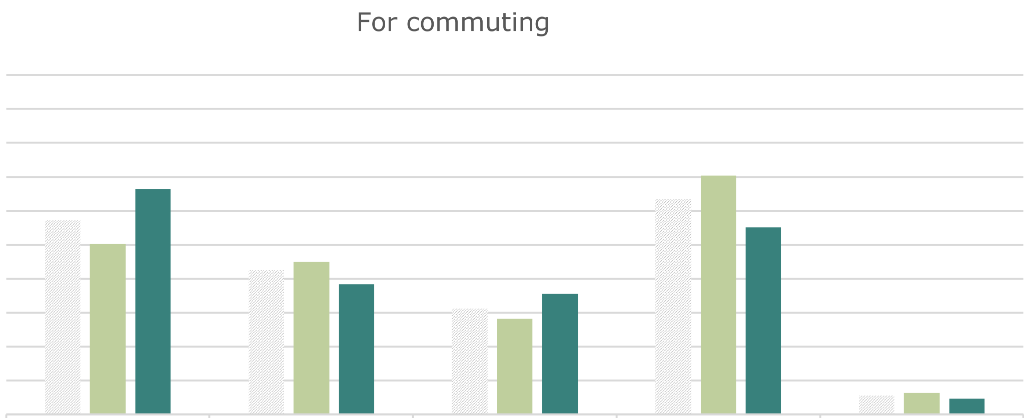
Figure 6.7: Responses to the question "How often do you cycle for other daily movements?" by gender

Wishfulness to ride more

In order to know more about the respondents' preferences, they have been asked if they would like to ride more than they usually do.

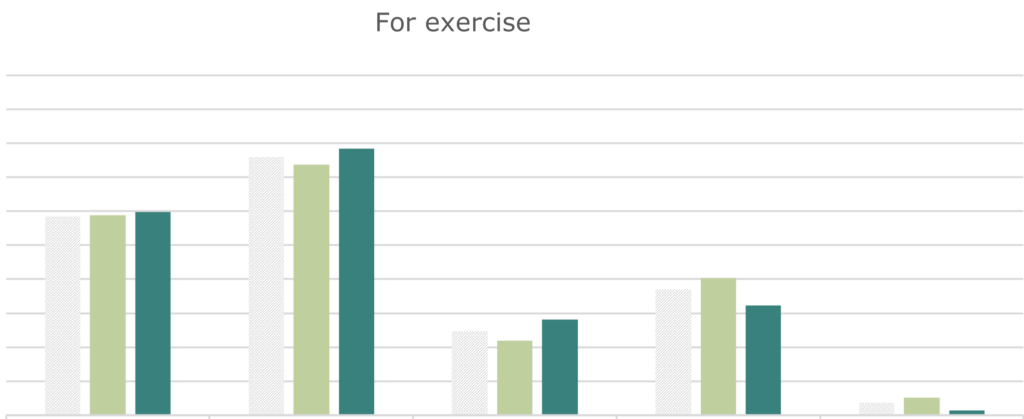
Half of the participants would like to cycle a bit or a lot more regardless the purpose. Around 12-18% of the studied population believes that they already ride enough and, therefore, they would not like to change their cycling behaviour for any reason. Morevoer, even though cycling share has resulted to be very low (Figure 6.4. to 6.7.), one third of the participants would not like to commute by bicycle (Figure 6.9.) or cycle for other daily movements more (Figure 6.11.).

The gendered analysis show that women would like to ride more than men for leisure purposes (Figure 6.10.) and other daily movements (Figure 6.11.) whereas more men would like to commute by bicycle more than women (Figure 6.8.). There are no major differences between females and males' preferences of changing their routines when it comes to exercise motivations (Figure 6.9.).



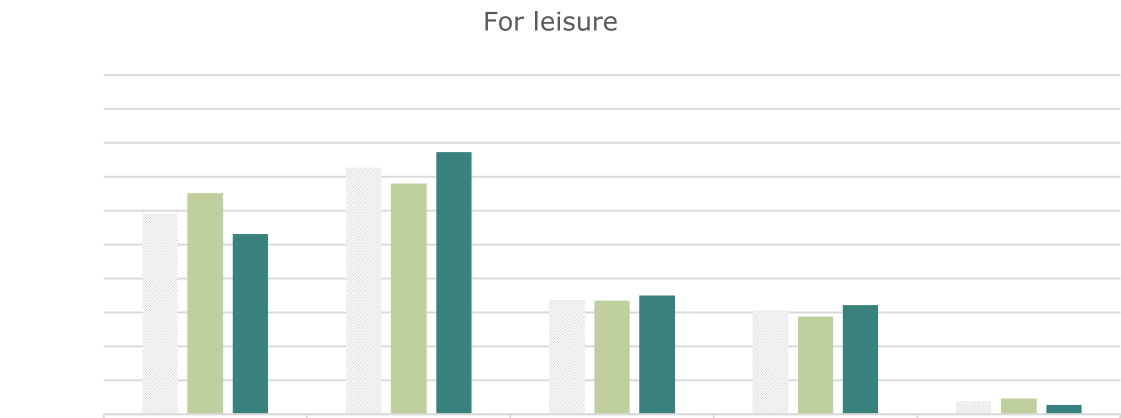
	Yes, a lot more	Yes, a bit more	No, I already ride enough	No	No answer
Total	28,6%	21,3%	15,6%	31,7%	2,8%
Women	25,1%	22,5%	14,1%	35,2%	3,2%
Men	33,2%	19,1%	17,8%	27,5%	2,3%

Figure 6.8: Responses to the question "Would you like to ride more for commuting purposes?" by gender



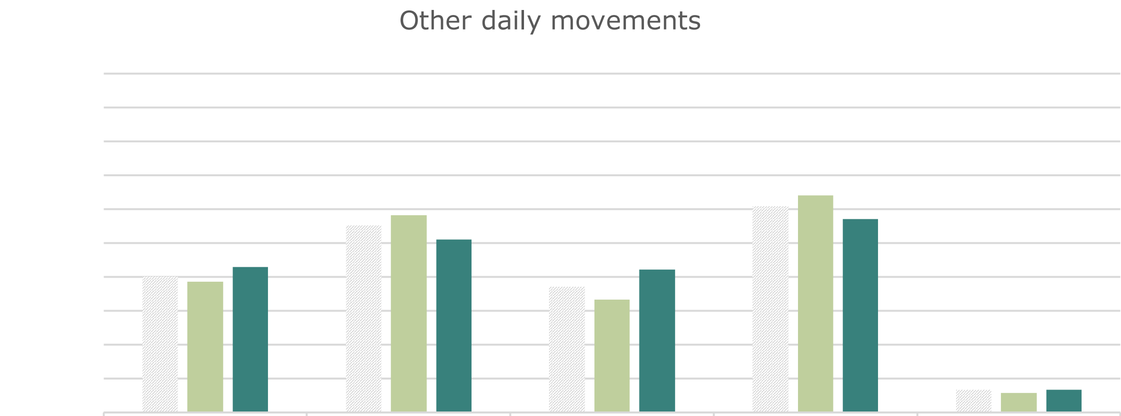
	Yes, a lot more	Yes, a bit more	No, I already ride enough	No	No answer
Total	29,2%	38,0%	12,4%	18,5%	1,8%
Women	29,4%	36,9%	11,0%	20,2%	2,6%
Men	29,9%	39,3%	14,1%	16,1%	0,7%

Figure 6.9: Responses to the question "Would you like to ride more for exercise purposes?" by gender



	Yes, a lot more	Yes, a bit more	No, I already ride enough	No	No answer
Total	29,6%	36,3%	16,8%	15,3%	2,0%
Women	32,6%	34,0%	16,7%	14,4%	2,3%
Men	26,5%	38,6%	17,4%	16,1%	1,3%

Figure 6.10: Responses to the question "Would you like to ride more for leisure purposes?" by gender



	Yes, a lot more	Yes, a bit more	No, I already ride enough	No	No answer
Total	20,1%	27,6%	18,5%	30,5%	3,4%
Women	19,3%	29,1%	16,7%	32,0%	2,9%
Men	21,5%	25,5%	21,1%	28,5%	3,4%

Figure 6.11: Responses to the question "Would you like to ride more for other daily movements?" by gender

6.2.3 Reasons for cycling or not

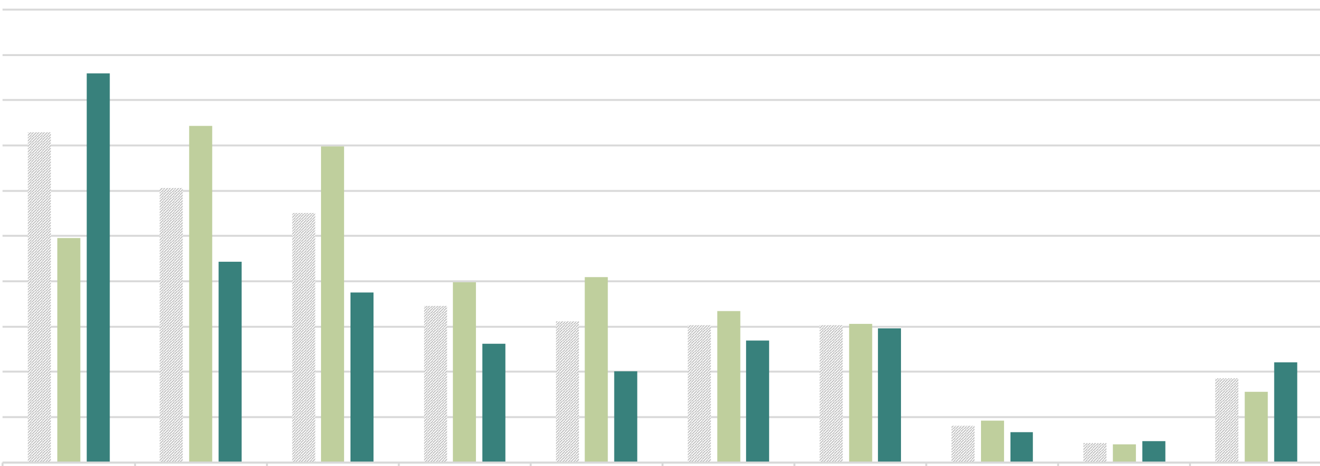
Questions regarding the motivators and constraints for bicycling participation have been asked. In these two topics, the participants could choose more than one option to answer.

In addition, the respondents have been given the posibility to write other reasons. It is worth mentioning that only 22 of them reported other possible reasons for cycling while 61 suggested different reasons for not cycling.

Reasons for not cycling

Figure 6.12. reveals that around a third of the inviduals indicated that municipality is not adapted and they are not used to/laziness as the most relevant reasons for not cycling. Reasons such as the preference of walking, fear/uncomfortability, having to do multiple trips in one journey and worry of getting their bicycle stolen accounted for 15%. Only a few indicated that not liking/wanting to cycle or health issues are reasons strong enough for finally deciding not to cycle.

It is also worth mentioning that 36,5% of the participants (43,0% of all men, 24,8% of all women) did not choose any reason as they stated that they do ride.



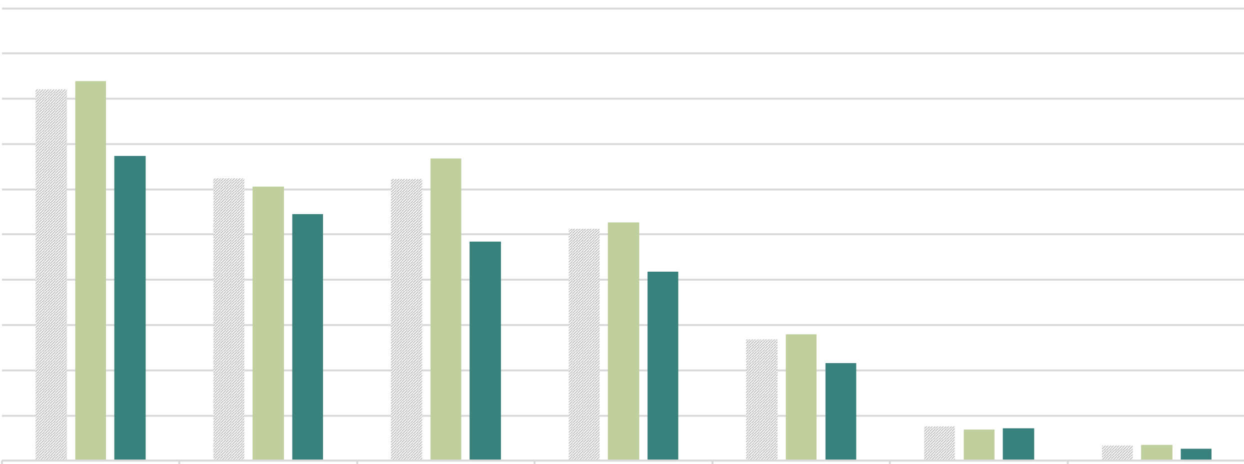
	I do ride	Municipality not adapted	Not used to/Laziness	Prefer walking	Afraid/Uncom fortable	Multiple trips in one journey	Bicycle theft	Do not like/do not want to	Health issues	Other
Total	36,5%	30,3%	27,5%	17,3%	15,6%	15,1%	15,1%	4,0%	2,2%	9,3%
Women	24,8%	37,2%	34,9%	19,9%	20,5%	16,7%	15,3%	4,6%	2,0%	7,8%
Men	43,0%	22,1%	18,8%	13,1%	10,1%	13,4%	14,8%	3,4%	2,3%	11,1%

Figure 6.12: Reasons for not cycling by gender

Men and women diverged on the explanatory factors for not riding (Figure 6.12.). More women than men reported all the reasons to be relevant, except for bicycle theft and health issues. Much higher percentages of female indicated not being used to/laziness (34,9% vs 18,8%), municipality not being adapted for bicycles (37,2% vs 22,1%) and being afraid or uncomfortable at a higher rate than men (20,5% versus 10,1% respectively). Women also tend to prefer walking more than men. Issues such as bicycle theft, not liking riding and health issues were relevant for female and male to the same extent.

Reasons for cycling

The great majority (81,1%) of individuals cycles because it is a way of practising exercise. Two thirds of them do it because it is a fast way of travelling and because of environmental reasons. A quarter decide to cycle influenced by the high price of public transport/gasoline and only very few ride in consequence of not having a driving licence or because of other reasons (Figure 6.13.).



	Way of doing exercise	Fast for short/medium distances	Care for the environment	Riding makes me feel free	Public transport/gasoline is too expensive	Do not have driving licence	Other
Total	82,0%	62,5%	62,3%	51,3%	26,8%	7,6%	3,4%
Women	83,9%	60,5%	66,9%	52,7%	28,0%	6,9%	3,5%
Men	67,4%	54,5%	48,4%	41,8%	21,6%	7,2%	2,6%

Figure 6.13: Reasons for cycling by gender

As it happened in the analysis explanatory analysis for not cycling, women found all the reasons to be more relevant than men (Figure 6.13.). The percentages differed the most for caring for the environment and considering cycling as a way of doing exercise. Following by feeling free when riding, thinking public transport/gasoline is too expensive and considering bicycles as fast for short/medium distances.

6.2.4 Factors influencing the choice of cycling

The importance of factors, both positive and negative, influencing the choice of cycling will be presented in the following sections. Once again, the possible answers listed result of previous literature review.

Positively

Figure 6.14. shows that issues related to quality and quantity of cycling infrastructures influence participants the most. Followed by greenery and parking available at destinations. Bad transport network (such as bus service more than five minutes walk away) seems to be the least influential factor of all.

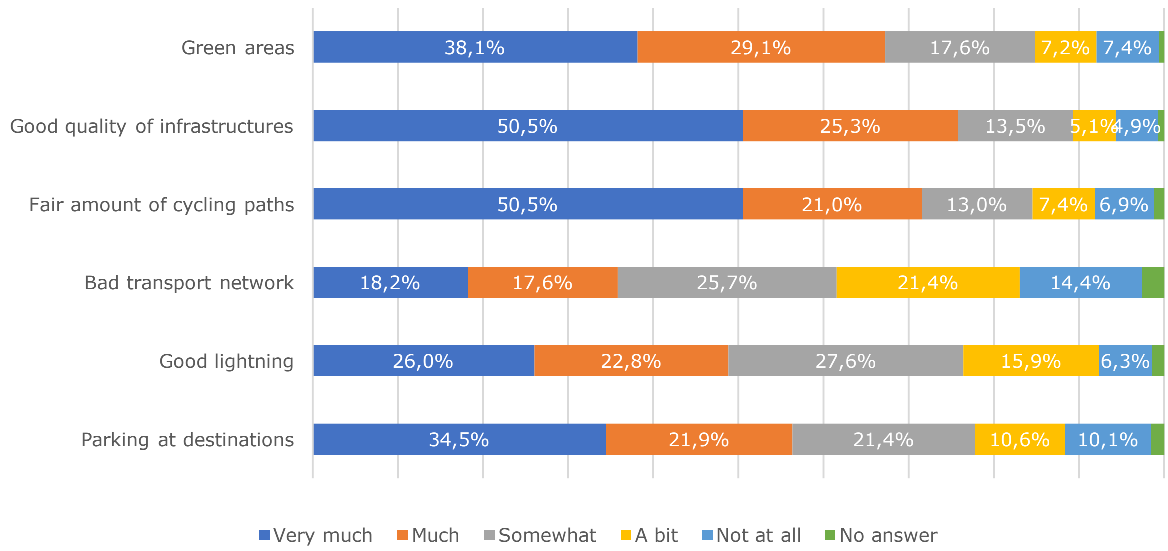


Figure 6.14: Factors affecting the choice of cycling in a positive way cycling

Overall, a great number of women tend to think that all the determinants listed affect their decision of cycling very much/much. By contrast, men tend to indicate that all the elements are less important than they are for women. Good lightning accounts for the biggest difference of relevancy: the double of women (36,0%) than men (14,4%) think having good illumination on the road is very much important (Table 6.5.).

		Very much	Much	Somewhat	A bit	Not at all	No answer
Women	Green areas	45,8%	29,4%	13,3%	5,2%	5,8%	0,6%
	Good quality of infrastructures	54,2%	27,7%	10,7%	3,5%	3,2%	0,9%
	Fair amount of cycling paths	56,2%	21,3%	12,1%	4,6%	4,0%	1,7%
	Bad transport network	23,9%	18,7%	23,9%	18,4%	12,1%	2,9%
	Good lightning	36,0%	23,3%	23,6%	10,1%	5,2%	1,7%
	Parking at destinations	40,1%	22,5%	17,6%	8,6%	8,6%	2,6%
Men	Green areas	29,5%	29,5%	23,2%	9,1%	8,4%	0,3%
	Good quality of infrastructures	47,3%	23,2%	16,4%	6,7%	5,7%	0,7%
	Fair amount of cycling paths	45,0%	21,1%	14,1%	10,4%	8,7%	0,7%
	Bad transport network	11,4%	16,8%	28,5%	25,2%	16,1%	2,0%
	Good lightning	14,4%	22,8%	32,6%	23,2%	6,4%	0,7%
	Parking at destinations	28,2%	21,8%	25,8%	13,1%	10,7%	0,3%

Table 6.5: Factors affecting the choice of cycling in a positive way cycling by gender

Negatively

Bad weather such as very hot and cold temperatures or rain and traffic speed are by far the determinants that have the biggest negative influence on the participants' cycling decision (Figure 6.15.). Followed by traffic density, hilliness, pollution and health issues, at last.

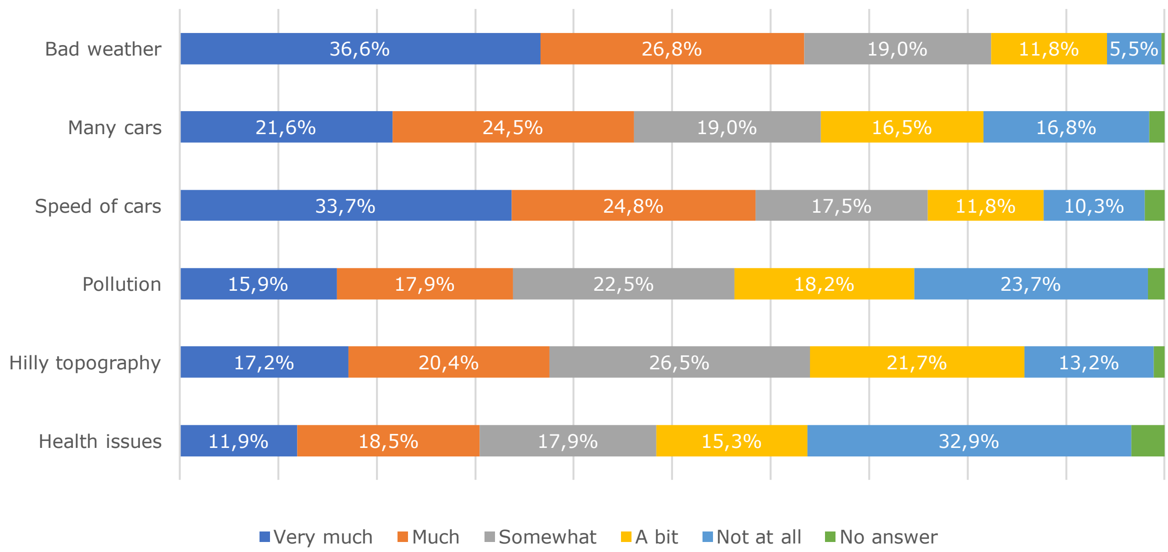


Figure 6.15: Factors affecting the choice of cycling in a negative way cycling

The gendered analysis of factors affecting negatively the cycling decision show large differences between men and women: once again, all of the factors seem to be of greater relevance for females than males. The biggest difference of opinions is shown in the hilliness percentages. A quart of the female think it affects their decision of riding very much whereas only 7,4% of the male think so (Table 6.6.).

		Very much	Much	Somewhat	A bit	Not at all	No answer
Women	Bad weather	42,9%	25,4%	14,7%	12,4%	4,0%	0,6%
	Many cars	27,1%	28,0%	19,6%	11,5%	12,7%	1,2%
	Speed of cars	41,5%	26,8%	13,8%	7,5%	8,1%	2,3%
	Pollution	21,0%	17,3%	20,2%	15,9%	23,1%	2,6%
	Hilly topography	25,4%	22,5%	26,5%	15,9%	8,1%	1,7%
	Health issues	13,8%	19,9%	18,2%	12,7%	30,8%	4,6%
Men	Bad weather	29,5%	28,9%	23,5%	11,1%	7,0%	0,0%
	Many cars	15,1%	20,8%	18,5%	22,5%	21,1%	2,0%
	Speed of cars	24,8%	22,5%	22,1%	17,1%	11,7%	1,7%
	Pollution	10,4%	19,1%	25,5%	21,1%	23,2%	0,7%
	Hilly topography	7,4%	18,1%	26,8%	28,9%	18,5%	0,3%
	Health issues	10,1%	17,1%	17,4%	18,5%	34,9%	2,0%

Table 6.6: Factors affecting the choice of cycling in a negative way cycling by gender

6.2.5 Improvements needed

On-route

Although more and separated cycling paths are the most preferred improvements, wider paths, traffic calming measures and good lightning also account for high percentages (Figure 6.16.). Overall, the majority of participants rated all the proposed measures as very much or much important.

Table 6.7. shows that, again, all the elements are mostly considered as very much/much important by females. Having sufficient street lights and wider cycling lanes are considered to be more important for women than men. Traffic calming measures seem to have more or less the same relevance for both genders.

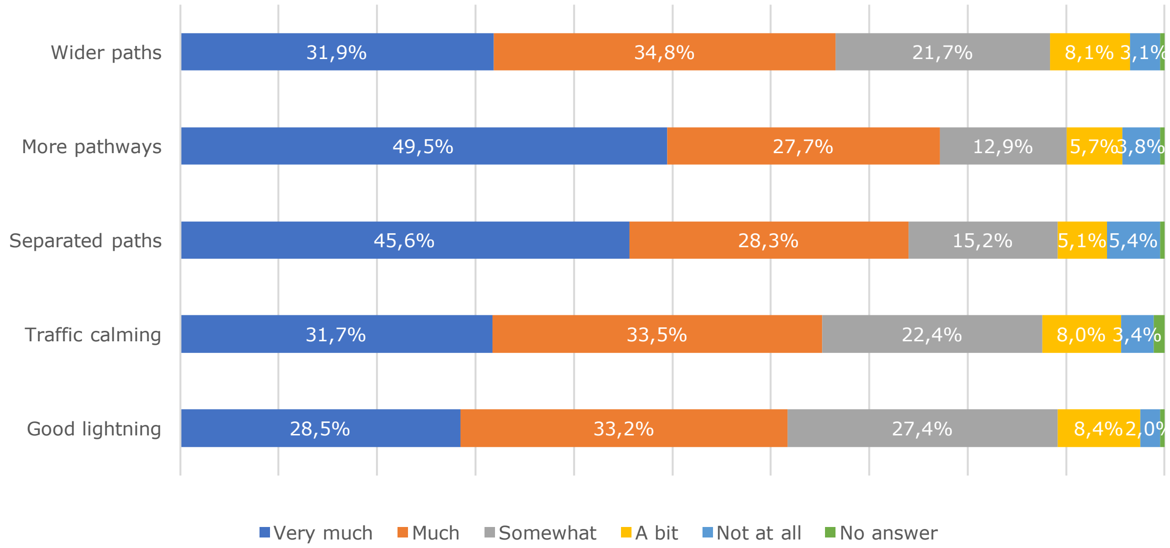


Figure 6.16: On-route improvements needed

		Very much	Much	Somewhat	A bit	Not at all	No answer
Women	Wider paths	38,3%	36,3%	17,9%	5,5%	1,4%	0,6%
	More pathways	56,2%	24,2%	13,5%	3,5%	2,3%	0,3%
	Separated paths	53,0%	28,2%	12,4%	2,6%	3,2%	0,6%
	Traffic calming	35,4%	36,0%	18,7%	6,1%	2,3%	1,4%
	Good lightning	37,8%	32,9%	21,9%	4,9%	1,7%	0,9%
Men	Wider paths	24,2%	33,2%	26,5%	11,4%	4,4%	0,3%
	More pathways	42,6%	31,2%	12,4%	8,1%	5,0%	0,7%
	Separated paths	37,6%	28,2%	18,8%	8,1%	7,0%	0,3%
	Traffic calming	27,2%	30,9%	26,5%	10,4%	4,4%	0,7%
	Good lightning	17,4%	33,6%	33,9%	12,8%	2,3%	0,0%

Table 6.7: On-route improvements needed by gender

At destination

The existence of cycling lanes until final destination and secure parking facilities are, by far, the most important elements to be improved at destination according to the respondents (Figure 6.17.). By contrast, less than half of the individuals think that the availability of showers and changing rooms, having lockers accesible or the existence of bicycle maps are relevant matters.

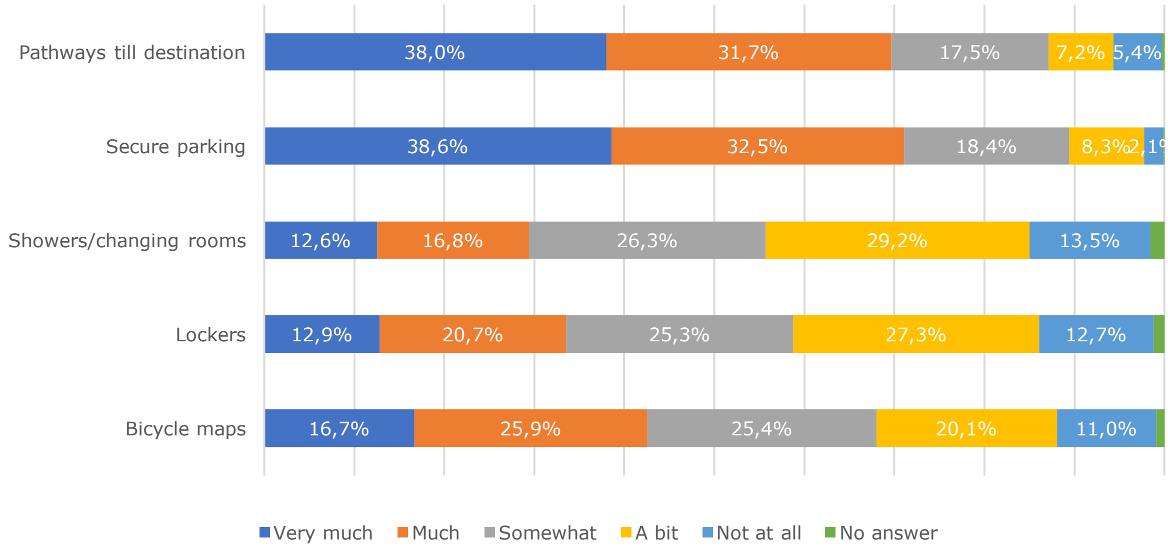


Figure 6.17: Destination improvements needed

In the study population, more women than men reported that pathways until final destination and having secure parking are measures very much needed. According to Table 6.8., the existence of showers, changing rooms and lockers are equally relevant for both male and female.

		Very much	Much	Somewhat	A bit	Not at all	No answer
Women	Pathways till destination	47,6%	29,4%	14,4%	4,9%	3,7%	0,0%
	Secure parking	42,9%	32,6%	15,9%	7,2%	1,4%	0,0%
	Showers/changing rooms	12,4%	13,5%	28,5%	30,3%	13,5%	1,7%
	Lockers	13,8%	17,3%	26,8%	28,5%	12,4%	1,2%
	Bicycle maps	20,5%	28,0%	25,6%	17,0%	7,8%	1,2%
Men	Pathways till destination	27,2%	34,9%	20,5%	10,1%	6,7%	0,7%
	Secure parking	33,6%	32,9%	21,1%	9,7%	2,7%	0,0%
	Showers/changing rooms	13,1%	21,1%	24,2%	27,9%	12,8%	1,0%
	Lockers	11,7%	25,2%	23,8%	25,2%	13,1%	1,0%
	Bicycle maps	12,1%	23,8%	25,5%	23,8%	14,4%	0,3%

Table 6.8: Destination improvements needed by gender

6.2.6 Comfort and safety concerns

Questions related to comfort and safety have ben also included in the questionnaire.

Comfortability on different types of lanes

Regarding preference indications, Figure 6.17. presents cycling lanes with physical barriers as the option were most people feel very comfortable/comfortable (82,9%). Yet, more than the half of the respondents also feel very comfortable/comfortable when cycling on a street with low traffic level (62,6%) and when cycling in a cycling lane with marking crossings (63,6 %).

On the contrary, many individuals feel uncomfortable using a road without cycling lane (38,7%). However, almost the same amount of people would ride even if feeling uncomfortable (34,8%) in the same cycling space (Figure 6.17.).

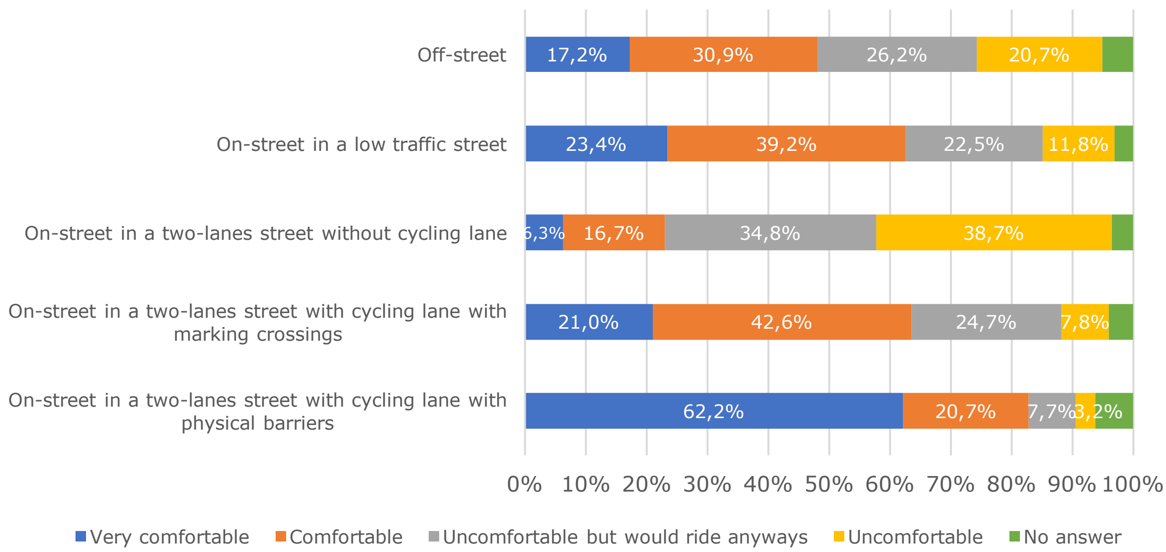


Figure 6.18: Comfortability on different types of lanes by gender

For use and comfortability levels, there exist statistically significant gender differences (Table 6.9.). Men tend to feel more comfortable than female in any given situation. Although both genders feel a similar comfortability level when riding on-street in a two-lanes street with cycling lane with physical barriers.

		Very comfortable	Comfortable	Uncomfortable but would ride anyways	Uncomfortable	No answer
Women	Off-street	13,0%	29,1%	28,0%	24,8%	5,2%
	On-street in a low traffic street	19,3%	36,3%	25,4%	16,1%	2,9%
	On-street in a two-lanes street without cycling lane	4,9%	11,2%	31,4%	49,0%	3,5%
	On-street in a two-lanes street with cycling lane with marking crossings	15,9%	42,7%	26,8%	10,7%	4,0%
	On-street in a two-lanes street with cycling lane with physical barriers	62,0%	20,5%	8,4%	3,2%	6,1%
Men	Off-street	22,1%	33,9%	23,8%	15,8%	4,4%
	On-street in a low traffic street	27,9%	42,6%	19,8%	6,7%	3,0%
	On-street in a two-lanes street without cycling lane	7,7%	22,8%	38,6%	27,9%	3,0%
	On-street in a two-lanes street with cycling lane with marking crossings	27,5%	43,0%	21,8%	4,4%	3,4%
	On-street in a two-lanes street with cycling lane with physical barriers	63,4%	20,8%	6,7%	3,0%	6,0%

Table 6.9: Comfortability on different types of lanes by gender

Personal safety concerns

Figure 6.19. shows that about 60% of all the participants are (very much/much) concerned about getting hit by a car. Some of them are afraid of falling or getting hurt whereas being mugged/attacked or hit by another cyclist are factors about which they worry the least.

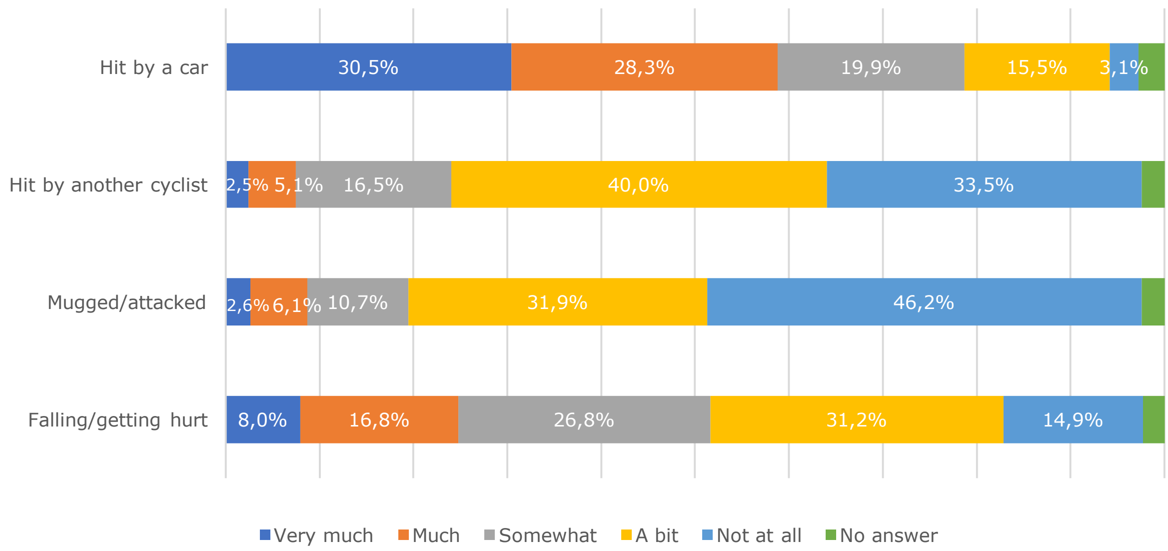


Figure 6.19: Personal safety concerns when riding

The biggest fear among the people surveyed is getting hit by a car and very few men and women are very much worried by any other reason than that. However, Table 6.10. shows that women are generally the ones who fear the most about their personal safety.

		Very much	Much	Somewhat	A bit	Not at all	No answer
Women	Hit by a car	38,0%	26,5%	17,6%	11,8%	2,9%	3,2%
	Hit by another cyclist	3,7%	6,1%	19,3%	42,7%	25,4%	2,9%
	Mugged/attacked	4,3%	8,1%	13,8%	34,0%	36,9%	2,9%
	Falling/getting hurt	11,2%	20,2%	25,9%	27,1%	12,7%	2,9%
Men	Hit by a car	22,1%	31,2%	22,1%	19,1%	3,4%	2,0%
	Hit by another cyclist	0,7%	4,0%	13,4%	36,6%	43,6%	1,7%
	Mugged/attacked	0,3%	4,0%	7,4%	29,5%	57,0%	1,7%
	Falling/getting hurt	3,7%	13,4%	27,9%	36,2%	17,4%	1,3%

Table 6.10: Personal safety concerns when riding by gender

Safety concerns when crossing intersections

Bicycle boxes are, by far, believed to be the safest measure when going through an intersection (Figure 6.20.).

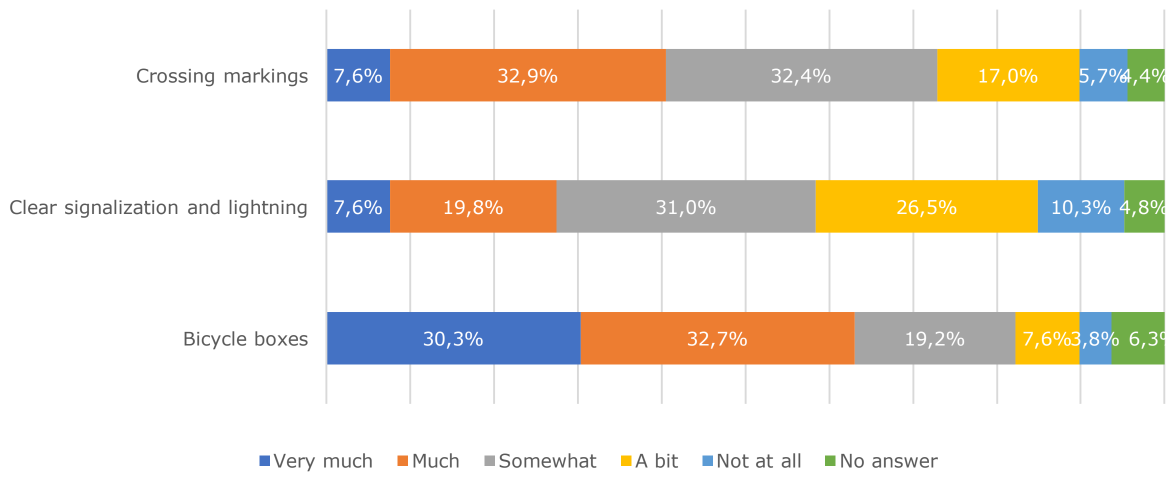


Figure 6.20: Safety concerns when crossing intersections

Table 6.11. does not present big gender differences regarding safety concerns when crossing intersections. Overall, there is not a clear opinion about if having clear signalization and lightning or crossing markings is considered to be very safe or very unsafe among either women nor men.

It is also worth mentioning that the percentage of participants who did not answer this question is higher than in other question (Table 6.11.).

		Very much	Much	Somewhat	A bit	Not at all	No answer
Women	Crossing markings	8,0%	31,8%	32,1%	17,9%	4,8%	5,4%
	Clear signalization and lightning	7,7%	14,3%	30,1%	29,8%	12,2%	6,0%
	Bicycle boxes	32,1%	31,8%	19,9%	6,5%	2,1%	7,4%
Men	Crossing markings	7,0%	34,5%	33,1%	16,4%	5,9%	3,1%
	Clear signalization and lightning	7,0%	26,5%	32,8%	23,3%	7,3%	3,1%
	Bicycle boxes	28,2%	33,8%	18,8%	9,1%	5,2%	4,9%

Table 6.11: Safety concerns when crossing intersections by gender

6.3 Respondents' opinion

At the end of the questionnaire, there was an open-ended question in which the respondents could write their general comments if they wanted to. A copy of the respondents' opinions (translated to English) is included in the appendix B.

There were 116 participants (56 females, 60 males) who wrote comments regarding the survey or the gender differences in cycling behaviour in general.

All the observations have been classified into three categories depending on if they are related to cycling in Spain (94), the survey itself (17) or other comments (5). The majority of comments were about cycling in Spain and the survey itself, thus a summary of these comments is presented hereunder.

6.3.1 Regarding cycling in Spain

The majority of the comments were related to the infrastructures. The predominant opinion among the respondents, both males and females, is that there is a lack of bicycle lanes in Spain. However, some people think that cyclists must oppose drivers by claiming their space on the road. They think no bicycle lanes should be designed as bicycles should occupy the roads. Car limitation measures were also frequently mentioned as a necessary measure. Participants also remarked the urgency of having secure infrastructures and more safety education among cyclists (e.g. about use of helmet) and other road users (e.g. respecting the minimum passing distance law). Comments regarding the need to integrate different means of transportation (such as offering discounts for bicycles on the train), the necessity of secure parking and the gravity of the environmental crisis as a big motivation for cycling were comments also repeated. Overall, all the respondents agreed that promoting bicycle use ensuring the safety of cyclists is vital.

6.3.2 Regarding the survey itself

A few people complained about the survey being long while some others thought more questions should have been asked. For example, some participants pointed out that questions including the weekly mileage or the purpose of cycling in childhood should be included. Some participants felt the need of leaving comments congratulating the existence of this survey.

7 Discussion

In this section, the importance of the different possible explanatory factors influencing cycling participation will be addressed and evaluated compared to previous literature.

A discussion of the analysis will be carried out following the same structure as in the Chapter 5. Additionally, methodology and limitations will be discussed at the end of this section.

7.1 Analysis discussion

7.1.1 Individual characteristics and cycling experience

Unquestionably, transport cycling is not very popular in Spain. If the results of this study are assumed to be representative of the Spanish population, half or more than half of the Spanish citizens never or almost never rode their bicycles for commuting purposes. Only around 10 % did so frequently. This aligns well with the Cycling Barometer (2017) survey carried out in 2017, according to which the transport cycling share in Spain was around 14 % (GESOP, 2017). Previous research in the field of gender inequality in transportation has demonstrated that countries with high cycling share had a better gender balance and women tended to commute by bicycle as much as men (Pucher and Buehler, 2008; Fishman et al., 2015). There was also a dissimilarity by gender among participants who never/almost never cycle for exercise purposes (60,8% of all female, 44% of all male), which may be related to women being less likely to meet the minimum accepted levels of physical activity than men (Colley et al., 2011). However, there were no big gender differences with respect to bicycle users with leisure motivations. This finding might be explained by thinking of leisure cycling as a relaxing activity (e.g. along parks or promenades), normally within infrastructures separated from motor traffic. The gendered analysis showed that women would prefer to ride more than men for leisure purposes whereas men would like to commute by bicycle more than women. Habits influence very much the choice of means of transportation. In Rimano's (2012) studies, many people reported that they did not commute by bike because they were not willing to change their routines of private cars usage.

In summary, in Spain, women tend to make fewer trips by bicycle regardless the purpose, a finding consistent to prior analysis. One may wonder if current gender inequalities in cycling participation are due to inequalities traced back to childhood since boys generally cycle more than girls at young ages (Tulach et al., 2015). The data gathered from the conducted survey confirmed that, in general, male cycled more and more frequently when they were children than female. The possible explaination for gender differences may be simply that the gender variation's agreement with the statement "I like biking" was notable (96,3% of male vs 85,3 % of female). However, the gendered choice of mode of transportation might be influenced not only by ejoyment but many other factors such as age (Laverty et al., 2013; Millett et al., 2013), characteristics of the trip and infrastructure design (Goodman et al., 2012; Panter et al., 2011) or car ownership (Lusk et al., 2014; Tulach et al., 2015). In agreement with Lusk et al.'s (2014) research, the results emphasized that the transport cycling share per week was higher among those who had a city bicycle. Individuals who had access to a car were less likely to bicycle for transport or other daily movements, which might be related to Spanish population considering cycling as fitness and pleasure-related activity. Motorcycle/kick scooter and road/mountain bicycle ownership account for the largest gender dissimilarities. However, the gender differences were almost non-existent among city bicycles owners and very little when considering the car. Is it because females tend to take up more household duties (such as grosery shopping) resulting in women thinking that cars may be their only option because of domestic responsibilities?

Previous literature also suggested that the amount of women who did not know how to ride in Spain was four times the amount of men (GESOP, 2017). Yet, contrary to that idea, almost all the respondents in the sample knew how to bicycle, with no gender-specific differences (98,3% of all women, 99,3% of all men).

7.1.2 Reasons for cycling or not

All the categories of determinants given for not wanting to cycle had a bigger influence for female riders. For example, much higher percentages of females (almost 2:1 compared to males) stated municipality being not adapted, not being used to cycling/laziness, preference of walking and being afraid/uncomfortable as very relevant reasons for not cycling. Reasons such as not being used to cycling/laziness and preference of walking are confirmed in previous literature. Women are more likely to walk or to use public transportation (Laverty et al., 2013; Panter et al., 2011; Yang et al., 2012) perhaps because females are more likely to practise regular low-intensity activities whereas males are more likely to practise regular high-intensity activity (Lustyk et al., 2004). Perceiving the municipality as unadapted for or being afraid or uncomfortable at a higher rate than men may be explained by women facing personal safety (thus, infrastructure safeness) in a different way and comfort seems to be more important to women than to men (Whitzman, 2007; Heesch et al., 2012).

As for reasons for cycling, the great majority of the women (83,9% women, 67,4% men) cycles because they think is a good way of practising exercise, which may explain the higher desire of cycling more for exercise reasons among female. More female (66,9%) than male (48,4%) participants use the bicycle because of environmental reasons. Agreeing with the finding of men being less likely than women to embrace environmentally friendly behaviours (Brough et al., 2016). A quarter of the sample population stated that their decision to cycle was influenced by the high price of public transport/gasoline confirming Buehler's (2012) findings that there exists a positive linking between the gasoline price and the percentage of commuting cycling trips. In a study about attitude towards cycling in Vitoria-Gasteiz (Spain), individuals also perceived as the most relevant positive aspects cycling being environmentally friendly, cheap and healthy (Lopez-Carreiro and Monzon, 2018).

7.1.3 Factors influencing the choice of cycling

Previous research found a positive association between active mode use and cycling infrastructure (Heinen et al., 2010; Mitra, 2013; Handy et al., 2014; Fraser and Lock, 2010). In line with that, around 70% of the females and two thirds of the male respondents thought that issues related to quality and quantity of cycling infrastructures and the existence of green areas, influence them the most when deciding whether to cycle or not. It makes sense as findings showed a positive association between active mode use and green areas (Wang et al., 2016; Fraser and Lock, 2010; Heinen et al., 2010). Women also assigned much more importance to the existence of good lightning. Good lightning accounted for the biggest difference of relevancy: the double of women (36,0%) compared to men (14,4%) thought having good illumination on the road is very important. Perhaps because perceptions of safety among women decrease quickly when it is dark (Inclusive city cycling, 2017).

Precipitation and temperature have a strong influence on the choice of bicycle commuting. The likelihood of biking to work doubles when there is no precipitation (Flynn et al., 2011). Bad weather and traffic speed were by far the determinants that have the biggest negative influence on the participants' cycling decision. The biggest gender difference of opinions was shown in the hilliness percentages, which may be linked to the previous mentioned different physical activity efforts among gender.

7.1.4 Improvements needed

This study suggested that gender differences in perceptions of bicycling safety combined with the existence of bicycle facilities could help to explain different cycling rates for men and women.

More and separated cycling paths were the most preferred on-route improvements within the participants, regardless the gender, which might be related to cyclists tending to feel safer when riding on protected bike lanes (Foster et al., 2015). However, having wider cycling lanes was considered to be more important for women than men. Studies revealed that the width of a bicycle path is positively related to the comfort as wider lanes offer more space for cycling (Li et al., 2012) perhaps due to women's greater risk aversion (Garrard et al., 2006).

The existence of cycling lanes until the final destination and secure parking facilities were, by far, the most important elements to be improved at the destination according to all the respondents. Previous research has found that women tend to prefer having secure bicycle parking stations and that the existence of bicycle parking spaces influences the use of bicycles positively (Pikora et al., 2003; Pucher et al., 2010; Sallis).

7.1.5 Comfort and safety concerns

The present study has documented evidence for the association between infrastructure designs and women's cycling share. Men felt more comfortable than female in any given situation (different types of lanes). Feeling comfortable using bicycle facilities is one of the strongest positive influences on women's bicycle use (Emond et al., 2009).

The biggest fear among the people surveyed was getting hit by a car and few men and women are very much worried by any other reason than that. However, women were the ones who fear the most about their personal safety in general.

Several studies have revealed that adequate infrastructure design in intersection, such as bicycle crossing markings, bicycle boxes and traffic calming measures, may significantly improve the bicyclists' safety perceptions at intersections (Wang et al., 2018) increasing the cycling share. In this study, bicycle boxes were believed to be the safest measure, by far, when going through an intersection. Findings showed that the presence of bike boxes leads to a reduction in bicycle–motor-vehicle conflicts (Dill et al., 2012; Loskorn et al., 2013). Thus, the presence of bicycle boxes can significantly increase all types of bicyclists' safety perceptions at intersections (Wang et al., 2018).

7.2 Methodological discussion

The number of participants (654) in the present study was quite high. However, Spain is a very big country and it is difficult to know if the sample is representative for the whole country. Ultimately, the overall sample was assumed to be representative as the target population was very diverse among gender, age and municipality size.

Moreover, the results are believed to be reliable. Statistically talking, for a 95% confidence level, the margin of error is narrowed to ±5% when a survey has at least 500 randomly-selected participants (Niles, 2006). Meaning that, for example, if half of the sample reported never or almost never cycling for any purpose, there would be a 95% probability that between 45% and 55% of the total population answered in the same way.

Limitations

Since the respondents were asked to think of their cycling habits through the year, it is assumed that the weather did not have an effect on the participants' answers.

If I were to conduct the survey again, the questionnaire would include questions related to weekly mileage. And the question related to intersections would be excluded as it did not provide any interesting information. A lot of people answered "no answer" in this question, which may be due to poorly understanding of the provided images.

As for the comparison with Norway, it was difficult to compare some aspects because some data was collected using different questions. Some of the issues were not compared because information regarding some topics was limited. If more time available and knowledge of Norwegian language, it would have been ideal to perform this paper's questionnaire among Norwegian.

8 Comparison between Spain and Norway

The second objective of this study is to evaluate if Spanish Transport Engineers can learn something from Norwegian ones. Thus, in this section, the cycling behaviour in Spain and Norway will be examined on a comparative basis.

In order to do so, results gathered from the survey carried out in this paper will be directly compared with the latest bicycle survey conducted in Norway (Bjørnson et al., 2018).

Differences and similarities between countries will also be contrasted by using previous papers in Spain (Marqués et al., 2014; Lopez-Carreiro and Monzon, 2018) and Norway (Bjørnskau et al., 2016; Backer-Grøndahl et al., 2007).

In addition, a summary of the differences between Spain and Norway regarding the design of cycling infrastructures (studied in Chapter 4) will be presented to obtain a better understanding of the results.

8.1 Differences and similarities in cycling participation

High levels of cycling participation are common in many countries of Central and Northern Europe (such as the Netherlands, Denmark, Sweden or Germany) (Pucher et al., 2014). Yet, in Mediterranean Countries, cycling share has only reached meaningful levels in a few cities (Marqués et al., 2014).

In order to explain similarities and differences referring the cycling behaviour between Spain and Norway, the cycling shares for different purposes in both countries will be analysed first by using data collected in the Norwegian Bicycle Survey (2017) (Bjørnson et al., 2018) and the Spanish survey carried out this study. Since the aim of this paper focuses on addressing gender differences, percentages will be presented by gender.

The possible answers of cycling frequency regarding different purposes were differently in the mentioned surveys. In the Norwegian questionnaire, possible answers given were: more than 4 days a week, 2 to 4 days per week, 1 day per week, 1 to 3 days per month, less than 1 day per month and never. In the Spanish questionnaire, possible answers given were: more than 4 days a week, 2 to 4 days per week, 1 day per week, 1 to 3 days per month and never/almost never. Thus, few changes regarding frequency have been carried out in order to be able to compare the results from both surveys.

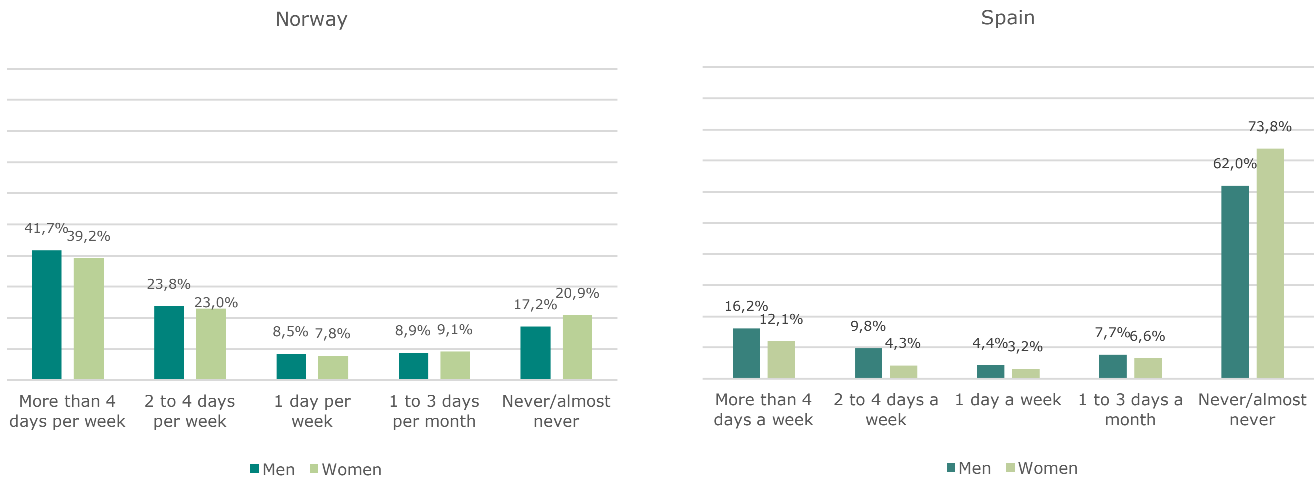


Figure 8.1: Cycling frequencies for commuting purposes by gender in Norway (Bjørnson et al., 2018) and Spain

There is a large difference between countries regarding the participation in commuting cycling. Around 60% of the population in Norway cycles for this purpose regularly per week opposing a 60% of the population in Spain who never commute by bike (Figure 8.1.).

In addition, the gender gap in transport cycling is almost non-existent in Norway as percentages are almost the same for all frequencies whereas in Spain, riding shares are higher for males than females.

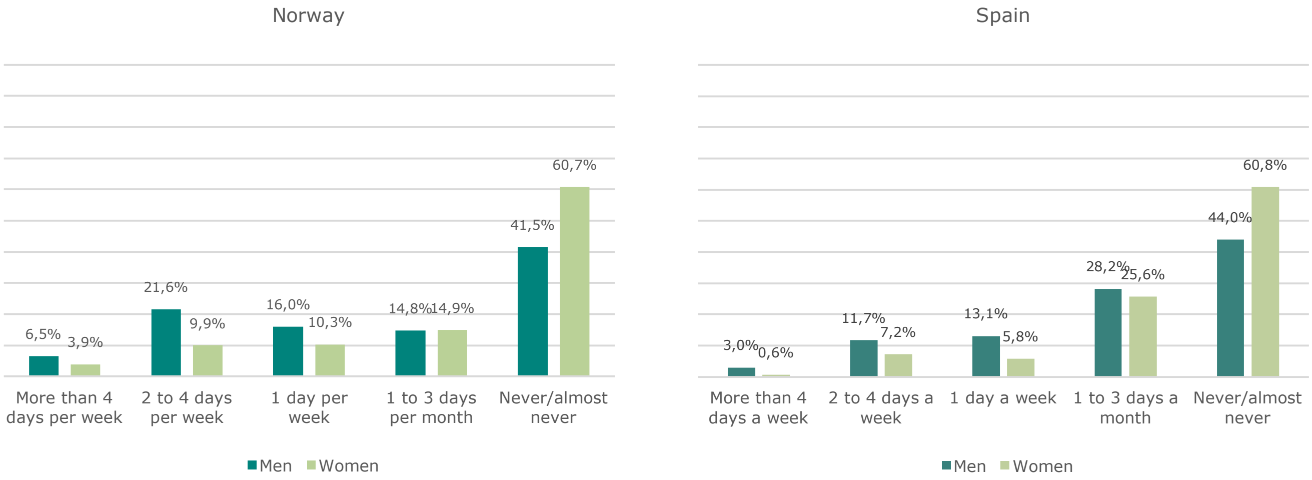


Figure 8.2: Cycling frequencies for exercise purposes by gender in Norway (Bjørnson et al., 2018) and Spain

Figure 8.2. shows the reduction of dissimilarities when comparing frequency among Norwegian and Spanish for exercise purposes. Yet, Norwegians account for higher percentages.

Inequalities between genders for this purpose are clear in both countries. Percentages of males cycling regularly for exercise per week in both countries (28,1% in Norway, 14,7% in Spain) are higher than percentages of females (13,8% in Norway, 7,2% in Spain) in both countries (Figure 8.2.).

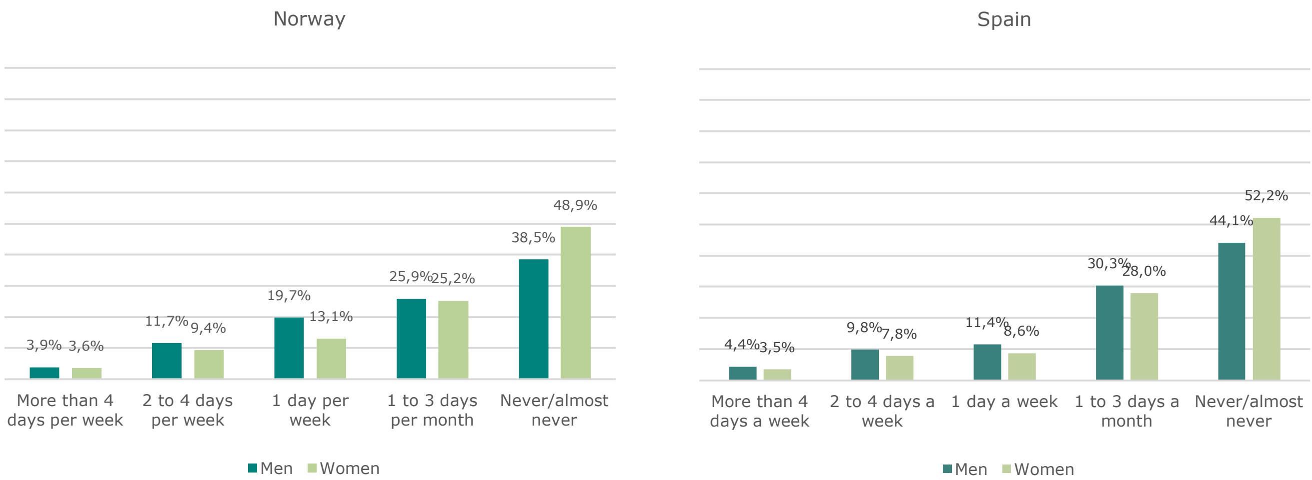


Figure 8.3: Cycling frequencies for leisure purposes by gender in Norway (Bjørnson et al., 2018) and Spain

As for leisure purposes (Figure 8.3.), differences in cycling shares are very small as both populations in Norway and Spain cycle more or less with the same frequency for this purpose. Percentages of very frequent cyclists (around 4%) and non-cyclists for leisure purposes (around 40%) are very similar among Spaniards and Norwegians.

Overall, the results clearly show that, in Norway, the majority of cycling is carried out to travel to and from work or school (Figure 8.1.). Yet, exercising and recreational cycling shares among Norwegians are much lower (Figures 8.2. and 8.3.) leading to a decrease in gender equality in cycling participation for such purposes. This outcome aligns to previous findings which conclude that gender balance is higher when the bicycling share is higher (Pucher and Buehler, 2008; Fishman et al., 2015). Perhaps, for this same reason (low cycling rates), the gender inequalities are much higher in Spain than in Norway. In particular, when analysing the percentages of women and men who never/almost never ride differences are very large for all purposes in Spain whereas just for exercise and leisure in Norway.

Differences between countries, specifically for commute cycling, might be explained by existing current cycling strategies (Statens Vegvesen, 2003) in Norway that promote cycling as mode of transport whereas, in Spain, the National Cycling Strategy Plan (PEEB 2019/2024) is still under development.

In Norway, the current cycling strategy's target includes an increment in the share of cycling to 10-20 %. According to Statens Vegvesen (2003), 8% of all trips should be made by bicycle at latest 2023. The Norwegian National Transport Plan's goal is that all future growth in individual transit in the largest cities in Norway should be performed by walking, cycling and public transport (Meld. St. 33, 2016-17). NCS (2012) also aims to provide a safe road network within 2 km radius near schools thus children and youth can walk or ride to school (Statens Vegvesen, 2003). Previous studies confirm the positive association between bicycle experience in the past and the current cycling participation in such a way that people with habits of bicycling in youth have higher likelihood of bicycling in adulthood (Xing et al., 2018).

In Spain, strategies aiming to increase the cycling share (PEEB 2019/2024) are still under development. However, the Cycling Plan in Seville (Spain) opens up a glimmer of hope. The urban cycling rose from almost non-existent participation to nine percent of the total mechanical trips between 2006 and 2011. This quick growth was mainly due to administration policies based on designing a cycle network bi-directional, homogeneous and segregated from motorised traffic while connecting the main attractions (Marqués et al., 2014).

8.2 Possible explanatory factors

Different cycling purposes have shown gender differences in cycling participation between Norway and Spain. However, as previously mentioned, findings show that there are many other factors (such as car/bicycle ownership, physical environment or the design of cycling facilities) that correlate with the bicycling choice.

Europeans are over twice as likely to use a private car than to use public transport or cycle on a regular basis (Eurobarometer 472, 2017). Men are more often drivers and less frequently public transport users (Laverty et al., 2013). In both countries, Norway and Spain, the large majority of the population owns or has access to at least one automobile (88% and 81%, respectively) and/or a bicycle (75% and 83%, respectively) (Figure 8.4.).

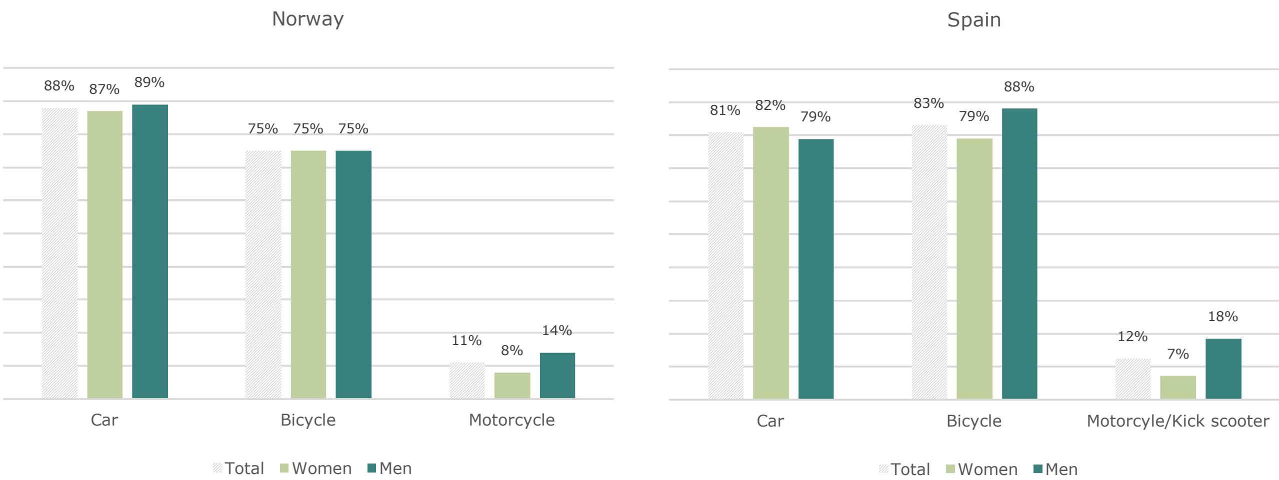


Figure 8.4: Different vehicles ownership by gender in Norway (Bjørnson et al., 2018) and Spain

Although literature (Lusk et al., 2014) establishes a negative connection between car ownership and cycling rates (people are likely to ride less when they own a car), in Norway, the amount of public transport users and people who walk is reduced notably among people who have access to a car (Table 8.1.) but the cycling share is not reduced among those who are car owners (Hjorthol et al., 2014). Thus, contrary to what happens in Spain (Table 8.2.), there is no association between bicycling participation and accessibility to private automobiles in Norway.

	Foot	Bike	Car	Public Transport
No car, no driving's licence	32%	9%	5%	54%
Car and driving's licence	22%	10%	28%	37%

Table 8.1: Association between transport shares and different vehicles ownership in Norway (Hjorthol et al., 2014)

Vehicle type	Never/almost never	1 to 3 days a month	1 day a week	2 to 4 days a week	More than 4 days a week
At least access to car regardless ownership of other vehicles	70%	7%	4%	7%	12%
At least access to city bicycle regardless ownership of other vehicles	58%	9%	5%	9%	20%

Table 8.2: Association between cycling frequency and different vehicles ownership (Spain)

Previous findings (Rimano, et al., 2012) suggest that people tend to mention emotional factors (both positive and negative) when asked to indicate reasons that influence their decision of riding. In the Norwegian study, the respondents were requested to state why they chose to bicycle the day they were interviewed. Being the fastest stood out as the most frequently mentioned reason followed by being cheap and a way of training (Figure 8.5.). In this papers' survey, participants could choose from a list of different reasons. In Figure 8.5., the most chosen ones among the Spanish participants are represented. Although, bicycle being an environmentally friendly mean of transportation accounts for much higher percentage (62%) within Spanish cyclist. Overall, it seems like both Norwegian and Spanish cyclists share similar motivators for riding.

It is worth mentioning that in the Norwegian study, participants were requested to think of the reasons why they chose to ride whereas, in the Spanish one, participants were given possible answers that they could choose from. This may have influenced the results leading to higher percentages among Spanish.

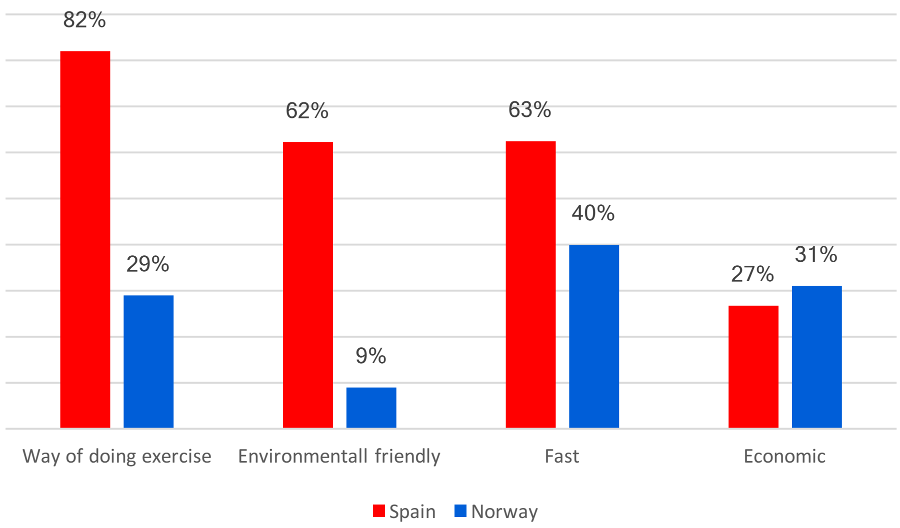


Figure 8.5: Main reasons for cycling in Norway (Bjørnson et al., 2018) and Spain

Another possible explanation for the differences in cycling participation may be the cycling conditions since the physical environment influences riders' perception of comfort (Li et al., 2011).

In this sense, minor changes regarding the rates of factors influencing the decision of cycling have been carried out in the Norwegian studies (Table 8.3.). In the Norwegian questionnaire, the Likert scale was based on a seven-point scale from 1= very dissatisfied to 7= very satisfied whereas, in the remaining surveys, the answers given were based on a five-point Likert scale from 1= not at all to 5= very much. Thus, average scores from the Norwegian Bicycle Survey (Bjørnson et al., 2018) have been adjusted to a five-point scale. Both surveys comprised different topics but only the comparable factors are displayed in Tables 8.3 and 8.4. Nonetheless, Norwegian and Spanish questionnaires were formulated differently. Therefore, the average scores of both countries will be analysed separately. Anyhow, this evaluation may help to draw conclusions about the most relevant aspects influencing the cycling decision in both countries.

Table 8.3. presents the average level of satisfaction on diverse issues and the relevance of different insecurities when cycling at day and night time were rated by Norwegian cyclists. In general, Norwegian cyclist were contented with the cycling facilities (quality and quantity) and the municipalities' suitability for cycling activities (Table 8.3.). Although the level of satisfaction was the maximum when rating facilities' safety, aspects including motor vehicles (amount and speed of cars) were the most problematic as well. As for the insecurities, Norwegian participants were mostly worried about poor infrastructures (bad conditions) at daytime and poor light at night. Poorly maintained facilities and unclean environments (Bedimo-Rung et al., 2005) have been shown to influence physical activity participation negatively.

	Variable name	Range	Average score	Description
Bjørnson et al., 2018	***To what extent are you satisfied with***			Average scores based on a five-point scale, being 1= not at all to 5= very much.
	Safeness	[1,5]	3,36	
	Your city as a cycling city	[1,5]	2,88	
	The quality of paths	[1,5]	2,79	
	The extent of cycling paths	[1,5]	2,78	
	Noise conditions	[1,5]	2,62	
	Air pollution	[1,5]	2,56	
	Speed motor vehicles	[1,5]	2,41	
	Number of cars	[1,5]	2,29	
	Interaction with other road users	[1,5]	2,49	
Backer-Grøndahl et al., 2007	***To what extent are you worried about… at daytime***			
	Bad conditions	[1,5]	2,89	
	Traffic being too close	[1,5]	2,76	
	Bicycle theft	[1,5]	2,37	
	To what extent are you worried about… at evening/night			
	Poor light	[1,5]	2,84	
	Bicycle theft	[1,5]	2,45	
	Unpleasant people	[1,5]	2,22	

Table 8.3: Factors influence the decision of cycling (Norway)

Table 8.4. shows different factors scored by Spanish respondents. In this case, all the factors were graded equally, in such a way that the higher the averages the higher the relevance. Overall, the most important positive factors were good quality and quantity of cycling infrastructures (followed by parking spaces and good lightning) whereas speed and amount of cars were the most frequently mentioned negative factors.

	Variable name	Range	Average score	Description
This paper's Survey	***To what extend affects (negatively) your decision of cycling***			Average scores based on a five-point scale, being 1= not at all to 5= very much.
	Speed of cars	[1,5]	3,54	
	Many cars	[1,5]	3,13	
	Pollution	[1,5]	2,79	
	To what extend affects (positively) your decision of cycling			
	Good quality of infrastructures	[1,5]	4,09	
	Fair amount of cycling paths	[1,5]	3,97	
	Parking at destinations	[1,5]	3,55	
	Good lightning	[1,5]	3,42	
	Bad transport network	[1,5]	2,96	
	To what extend are these improvements important for your decision of cycling			
	More pathways	[1,5]	4,12	
	Separated paths	[1,5]	4,02	
	Secure parking	[1,5]	3,97	
	Pathways till destination	[1,5]	3,89	
	Wider paths	[1,5]	3,83	
	Good lightning	[1,5]	3,76	

Table 8.4: Factors influence the decision of cycling (Spain)

Lightning conditions are very important because perceptions of safety among women drop quickly when it is dark (Inclusive city cycling, 2017). A woman who needs to travel at night through isolated areas might not feel safe enough to cycle or even her social surrounding might discourage her (Heinen et al., 2010). However, it may be worth noting that, in Norway, the feeling of safety when out in the dark is very high compared to other European countries. 88% of the Norwegians answered affirmatively when asked if they felt safe walking alone in their local areas after dark (Backer-Grøndahl et al., 2007).

Such high ratings in feeling of being safe while riding in Norway (Table 8.3.) might also be related to the helmet usage. Even though helmet use is mandatory among Spanish adolescents (Molina-García et al., 2016) and it is optional in Norway (ISMO, 2017). On average, the share of individuals using helmet in Norway is 70,8% (Bjørnson et al., 2018)) while, in Spain, only 59,5 % of cyclist use helmet (GESOP, 2017).

Safety concerns may be also linked to the fact that in Spain is prohibited to ride along the sidewalks where cyclists are allowed to cycle along sidewalks in Norway, which may contribute to increasing the general feeling of safety.

Safety is likely to be a significant barrier for women wanting to cycle (Schintler et al., 2000). Norwegian respondents were asked to what extent they were thinking of the possibility of being exposed to an accident when traveling on various means of transport. The results show that they were generally more concerned about accidents on all means of transport that go in road traffic (such as bicycle and car) than train or tram traffic (Backer-Grøndahl et al., 2007). Results from the Spanish survey emphasized that the majority of the respondents were concerned of being hit by a car, which means they are mostly worried about the interaction with road traffic as well. Questions regarding different safety experiences when cycling were asked among Norwegian and Spanish cyclists. Percentages are lower among Spaniards (Table 8.6.) than among Norwegians (Table 8.5.). This finding is contrary to the high safety ratings among Norwegians (Table 8.3.). Perhaps because Spanish participants were asked to think only about the last five years or simply because riding share in Spain is lower thus the probability of being harassed, pushed or robbed is little.

Have you ever been exposed to the following events as a traveller when cycling?			
	Men	**Women**	**Total**
Violence, threats	27%	19%	23%
Fallen or being pushed	27%	29%	28%
Unpleasant comments	46%	61%	53%
Being robbed	40%	35%	38%

Table 8.5: Personal experiences when cycling in Norway (Backer-Grøndahl et al., 2007)

Have you been exposed to the following events as a traveller when cycling in the last 5 years?			
	Men	**Women**	**Total**
Harassment	14%	22%	19%
Fallen or being pushed	22%	40%	25%
Being robbed	15%	17%	16%

Table 8.6: Personal experiences when cycling in Spain

Women being harassed or receiving unpleasant comments account for higher percentages (Tables 8.5. and 8.6.). Gender is one of the key variables associated with both offending and victimizing. The majority of crimes are committed by males (Vold et al. 2002). Consistent findings in research highlight that women fear crime more than men do (Mesch 2000; Pantazis 2000).

Anyhow, the most meaningful satisfactory factors and influential aspects among Norwegian and Spanish, respectively, are the same. However, it is impossible to measure exactly how satisfied Spaniards really are. The importance of improvements needed (Table 8.4.) confirmed the dissatisfaction regarding cycling facilities in Spain. More and wider cycling paths as well as separated cycling lanes till destination accounted for average scores around 4/5.

Van Goeverden et al. (2015) performed a revision on a number of Dutch and Danish cycling infrastructures and reached to the conclusion that cyclists prefer direct and segregated infrastructures sufficiently wide probably because bicyclists feel more comfortable while riding on spacious lanes separated from motor traffic (Foster et al., 2015). They also appreciated coloured pavement that marks their route. In an evaluation of cycle lanes in Oslo, the results show clearly that cyclists prefer cycle lanes that are wider than the standard and they also feel safer with wide bicycle lanes and red asphalt (Bjørnskau et al., 2016).

Gender inequalities in cycling participation may be explained by different perceptions in regard to the infrastructure’s attractiveness (Crane et al., 2017). However, according to literature review, the theoretical design of cycling infrastructures does not differ much between Norway and Spain (Table 8.7.). While bike boxes reduce the number of accidents between the vehicles and the cyclists (DGT, 2000), bicycle parking spaces and wide bicycle paths influence the use of bikes in a positive way (Pucher, et al., 2010; Li et al., 2012). A comfortable width of the cycling infrastructures is one of the strongest positive influences on female’s bicycle participation (Emond et al., 2009). Høye et al. (2015) reviewed the bicycle design guidelines from a number of countries (Figure 8.6.) concluding that the most recommended width is between 1,5 and 2,0 m (same as in Norway and Spain, Table 8.7.).

Cycling infrastructure design	Norway	Spain
Width	1,50 m (including clearance) or 1,70 m when high traffic levels (Statens Vegvesen, 2013)	1,50 m (including clearance) or 2 m when intense traffic levels (DGT, 2000)
Lightning	No guidelines regarding lightning in cycling paths have been found.	In urban areas, same lighting as in the road. In intersections, recommended to illuminate the cycle path around 50 m before the crossing (Generalitat, 2008).
Parking	Cyclists should be able to find the nearest bicycle parking within a walking distance of less than 25 m (Statens Vegvesen, 2013)	Parking for bicycles should be placed at a maximum distance of 50 m from points of interest. (IDAE, 2005).
Bike boxes	Its width is the bicycle lane width plus the lane width, while length should be 4-6 m (Statens Vegvesen, 2013)	Its width is the bicycle lane width plus the lane width, while length should be around 5 m (DGT, 2000)
Roundabout	In general, there should be no dedicated bicycle lane through roundabouts (Statens Vegvesen, 2013)	Separated bicycle lanes are mandatory within roundabouts (DGT, 2000)

Table 8.7: Design guidelines for cycling facilities in Norway and Spain

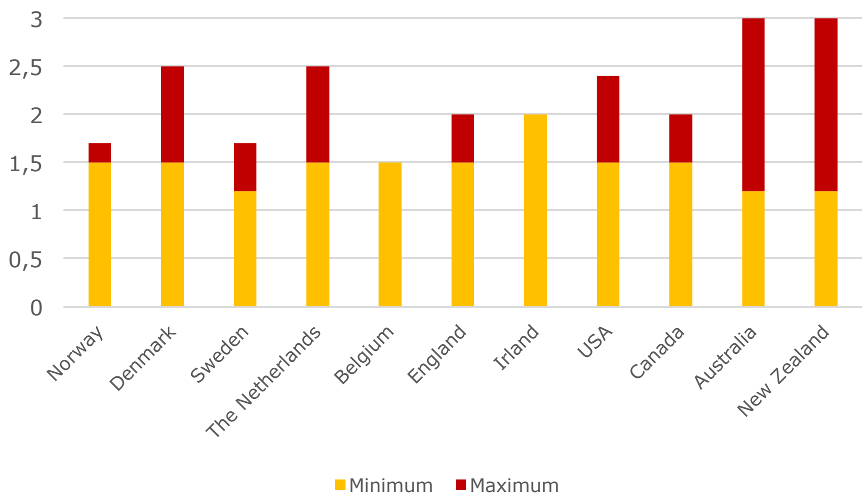


Figure 8.6: Maximum and minimum recommended width of cycling paths on a number of countries (Høye et al., 2015)

Studies consistently point out that the quantity of cycling facilities influence the cycling shares and that the quality of the street design (such as lightning and greenery) plays an important role in the decision to ride a bike. In countries with low cycling shares, cyclists are generally not satisfied with the cycling network (Jones, 2014), which may be the case in Spain. Afterall, comfort while bicycling plays an important role in explaining liking of bicycling (Xing et al., 2018).

Transport cycling share is quite high in Norway. Gender inequalities are almost non-existent in that case (Figure 8.1.), perhaps because the current cycling strategies are mainly focused on increasing the share of transport cycling. Promotion of cycling for other purposes might be ideal in order to shorten the gender differences in cycling for exercise and leisure purposes. However, with that in mind, Norway is yet another example that promoting cycling and having high cycling participation is one of the keys to reduce the gender differences in cycling.

As a matter of fact, in the mentioned countries, the Netherlands, Denmark and Germany, policies focusing on making space for cycling and limiting the car space within the cities lead to a rise in cycling rates (Van Goeverden et al., 2015). In those three countries, where the cycling share are very high, there has been an extensive investment on comfortable separate cycling facilities, bike parking places, traffic education and training (Pucher and Buehler, 2008).

9 Conclusion

This paper presents the findings of bicycle usage in Spain, focusing on gender preferences and differences. Research has been carried out trying to explain the reasons behind the existing cycling gender gap in Spain.

Based on a review of the literature, the results underline the relevance of different cycling purposes on influencing cycling choice. For example, in Spain, there were no big differences between genders with respect to cycling for leisure purposes. Although there are different barriers and motivators for cycling among women, the findings suggest that individual factors (such as age, enjoyment of cycling or car ownership) were important influences for both genders. It has been observed that comfortability while riding on bicycle facilities was the strongest positive influence among women. A finding which is supported by previous research since cycling participation tends to depend on the surrounding conditions. This finding suggests an indirect effect of bicycle facilities on bicycle use through their perceptions cycling safeness.

While history, culture, topography and climate are important factors to take into account when promoting cycling, they do not necessarily determine completely the cycling share levels (Pucher and Buehler, 2008). The outcomes from the comparison between Spain and Norway suggest that one of the key factors to close the existent gender gap in bicycle usage is the promotion of effective cycling strategies. Differences found in men's and women's cycling motivators and constraints should be considered when promoting cycling. Government policies that promote safe and convenient cycling for all (including children, the elderly, women and anyone with special needs) are the key to increase the cycling share.

In future studies, it would be important to study how cycling in youth influences later gendered cycling participation. Moreover, since infrastructure and physical environment are important to increase women's participation in cycling (Garrard et al., 2012), future research should investigate whether gender equality and quality of cycling infrastructures co-occur. In general, cycling experiences and needs of women should be investigated in more detail.

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Appendices

Appendix A: Questionnaire

Appendix B: Respondents’ opinion

Appendix A: Questionnaire

This survey is part of a Master’s Thesis where research about gender differences in cycling behaviour in Spain is being conducted.

The ultimate goal is to identify which factors influence you the most when deciding whether to cycle or not. Thus, answers from those who do not often ride are also interesting.

The survey should take no more than 5 minutes and your responses are completely anonymous.

Thanks in advance! We really appreciate your input.

First, we would like to know about your cycling experience, in general.

1. Do you own or have access to a car/bicycle?

[ ] Car
[ ] City bicycle
[ ] Road bicycle
[ ] Motorcycle
[ ] None
[ ] Other: ____________________

2. Can you ride a bike?

[ ] Yes
[ ] No

3. Do you like riding?

[ ] Yes
[ ] No

4. Did you ride when you were a child?

[ ] Never/Almost never
[ ] 1 to 3 days a month
[ ] 1 day a week
[ ] 2 to 4 days a week
[ ] More than 4 days a week

5. **How often do you cycle…? Please answer all the questions selecting the *most* correct answer for each case.**

	Never/Almost never	1 to 3 days a month	1 day a week	2 to 4 days a week	More than 4 days a week	No answer
…for transport (to go to workplace/school)	o	o	o	o	o	o
…for exercise (such as training)	o	o	o	o	o	o
…for leisure (such as going to the cinema)	o	o	o	o	o	o
…Other daily movements (such as going to the supermarket)	o	o	o	o	o	o

6. **Would you like to ride more…? Please answer all the questions selecting the *most* correct answer for each case.**

	No	No, I already ride enough	Yes, a bit more	Yes, a lot more	No answer
…for transport (to go to workplace/school)	o	o	o	o	o
…for exercise (such as training)	o	o	o	o	o
…for leisure (such as going to the cinema)	o	o	o	o	o
…Other daily movements (such as going to the supermarket)	o	o	o	o	o

7. In general, why do you not ride your bicycle? Possible answers can be chosen.

[ ] I do ride my bicycle

[ ] I am afraid/I do not feel comfortable

[ ] I do not like it/I do not want to

[ ] I prefer walking

[ ] I am not used to it/Laziness

[ ] I often do multiple trips in one journey (such as driving kids, going to the supermarket)

[ ] I live in a Municipality that it is not adapted for cycling transport

[ ] Health issues

[ ] Possible bicycle theft

[ ] Other: ____________________

8. In general, why do you ride your bicycle? Possible answers can be chosen.

[ ] Public transport/gasoline are too expensive

[ ] It is a way of doing exercise

[ ] I care for the environment

[ ] I do not have driving licence

[ ] Ride a bicycle makes me feel free

[ ] It is fast for short/medium distances

[ ] Other: ____________________

One purpose of this study is to find out why some people choose to ride and others do not.

9. Do some of the following factors affect your decision of cycling in a negative way? Please answer all the questions selecting the *most* correct answer for each case.

	Not at all	Very little	Somewhat	Much	Very much	No answer
Bad weather	o	o	o	o	o	o
Many cars	o	o	o	o	o	o
Speed of cars	o	o	o	o	o	o
Pollution	o	o	o	o	o	o
Hilly topography	o	o	o	o	o	o
Health issues	o	o	o	o	o	o

10. Do some of the following factors affect your decision of cycling in a positive way? Please answer all the questions selecting the *most* correct answer for each case.

	Not at all	Very little	Somewhat	Much	Very much	No answer
Green areas	o	o	o	o	o	o
Good quality of infrastructures	o	o	o	o	o	o
Fair amount of infrastructures	o	o	o	o	o	o
Bad transport (i.e. bus) network	o	o	o	o	o	o
Good lightning	o	o	o	o	o	o
Parking at destinations	o	o	o	o	o	o

11. To what extent are these on-route improvements important? Please answer all the questions selecting the *most* correct answer for each case.

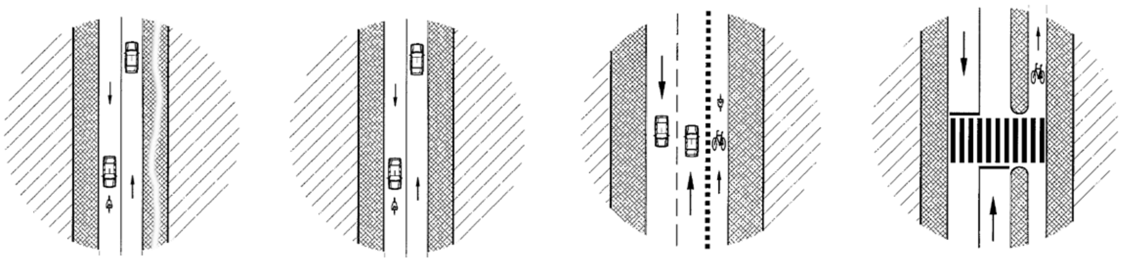
	Not at all	Very little	Somewhat	Much	Very much	No answer
Wider cycling infrastructures	o	o	o	o	o	o
More cycling infrastructures	o	o	o	o	o	o
Separated cycling infrastructures	o	o	o	o	o	o
Traffic calming measures	o	o	o	o	o	o
Good lightning	o	o	o	o	o	o

12. To what extent are these destination improvements important? Please answer all the questions selecting the *most* correct answer for each case.

	Not at all	Very little	Somewhat	Much	Very much	No answer
Bicycle lanes till final destination	o	o	o	o	o	o
Secure parking	o	o	o	o	o	o
Showers/changing rooms	o	o	o	o	o	o
Lockers	o	o	o	o	o	o
Bicycle maps	o	o	o	o	o	o

Another purpose of this study is to find out which comfort and safety concerns are most relevant when riding a bike. Please answer all the questions selecting the *most* correct answer for each case.

Below there are several figures that represent different possible scenarios.



Riding off-street (sidewalks, unpaved paths…) | **Two-lanes street without cycling lane** | **Two-lanes street with cycling lane with marking crossings** | **Two-lanes street with cycling lane with physical barriers**

13. Please, rate how comfortable you are when…

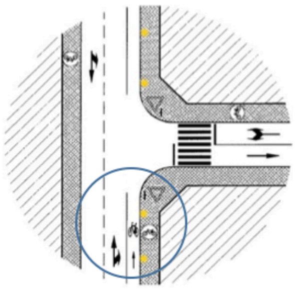
	Uncomfortable	Uncomfortable but would ride anyways	Comfortable	Very comfortable	No answer
Riding off-street (sidewalks, unpaved paths…)	○	○	○	○	○
Riding on-street in a low traffic street	○	○	○	○	○
Riding on-street in a two-lanes street w/o cycling lane	○	○	○	○	○
Riding on-street in a two-lanes street with cycling lane w/ marking crossings	○	○	○	○	○
Riding on-street in a two-lanes street w/ cycling lane with physical barriers	○	○	○	○	○

14. Please, rate how concerned you are of…

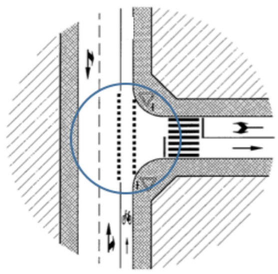
	Not at all	Very little	Somewhat	Much	Very much	No answer
Getting hit by a car	o	o	o	o	o	o
Getting hit by another cyclist	o	o	o	o	o	o
Getting mugged or attacked	o	o	o	o	o	o
Crashing, falling or getting hurt	o	o	o	o	o	o

Intersections are often seen as problematic because they are complex areas where many interactions can occur between bicyclists, motor-vehicles and pedestrians.

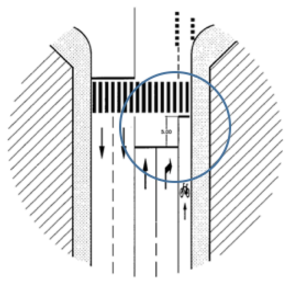
Below there are several figures that represent different possible scenarios.



Clear signalization and lightning
(drivers are aware of cyclists crossing because they are able to see them)



Crossing markings
(drivers are aware of cyclists because the cycling path is clearly marked)



Bicycle boxes
(drivers are aware of cyclists because when the streetlight is red, cyclists wait in front of cars)

15. Please rate how safe the following measures make you feel when crossing an intersection

	Not at all safe	Very little	Somewhat	Much	Very much safe	No answer
Clear signalization and lightning	○	○	○	○	○	○
Crossing markings	○	○	○	○	○	○
Bicycle boxes	○	○	○	○	○	○

In order to categorize the data collected, please answer the following questions.

16. Gender

[ ] Female
[ ] Male
[ ] No answer

17. How old are you?

[ ] Younger than 15;
[ ] 2= 15-20
[ ] 20-25
[ ] 25-30
[ ] 30-35
[ ] 35-40
[ ] 40-50
[ ] 50-60
[ ] Older than 60

18. Current occupation

[ ] Student
[ ] Employed
[ ] Housekeeping
[ ] Not working
[ ] Retired

19. Municipality

[ ] Less than 10 thousand habitants
[ ] 10 to 100 thousand habitants
[ ] 100 to 500 thousand habitants
[ ] More than 500 thousand habitants

20. We would appreciate if you had any suggestions regarding gender differences in cycling behaviour in Spain

[ ] I do not have any suggestion

[Please, write here your suggestions]

Again, thank you for your participation!

Appendix B: Respondents' opinion

1. Regarding cycling in Spain

<u>Infrastructures</u>

<u>Needed</u>

Spain lacks of segregated lanes for bicycles.

Man, 50-60, town, frequent cyclist for transport and other daily movements purposes

More cycling lanes are needed and they need to be safe.

Woman, 25-29, village, does not cycle for any purpose

If there is no bike lane… I do not know if it is better to ride on the sidewalk (police will fine you) or in the street (cars can run you over).

Man, 25-29, metropolis, does not cycle for any purpose

I would like to have more bike lanes and improvement of signalization in the existing ones.

Woman, 25-29, city, does not cycle for any purpose

Improvement in the infrastructures is needed. I've been living in Madrid for 10 years and the change is big but we need more!

Man, 50-60, metropolis, frequent cyclist for transport and other daily movements purposes

My city has a great offer of public bicycles with a great variety of stops well distributed throughout the city. However, there are few bike lanes, which forces people to move along sidewalks (prohibited) or on the road (dangerous).
Also, I do not use the bicycle as much as I would like due to the frequent rains and bad weather in my city.

Man, 25-29, city, frequent cyclist for transport purposes

Physical separation between road and bike lane is needed!

Man, 15-19, city, does not cycle for any purpose

Does not = never/almost never; Rare = 1 to 3 days a month: Occasional = 1 day a week; Frequent = 2 to 4 days a week; Usual = more than 4 days a week.
Village (<10 000 inhabit); Town (10 000 – 100 000 inhabit); City (100 000 – 500 000 inhabit); Metropolis (>500 000 inhabit).

I find this study very interesting, since we must encourage the use of the bike in Spain. I think Spanish people do not consider the bicycles as an alternative means of transportation. Adequate infrastructures must be built and private transport must be penalized.

Man, 25-29, city, frequent cyclist for exercise purposes

I do not use the bicycle as much as I would like because there are no proper lanes.

Woman, 35-39, city, frequent cyclist for transport, leisure and other daily movements

More bike lanes!

Woman, 15-19, town, rare cyclist for leisure purposes

I think the problem is that, in general, Spanish people do not think of the bicycle as a means of transport and the cities are not designed for cyclists.

Woman, 35-39, city, occasional cyclist for transport, leisure and other daily movements

It is important to build cycling lanes but it is necessary that infrastructures are well designed. In the city of Almeria, cycling lanes are painted in the middle of sidewalks so there are a lot of pedestrian crossing, visibility is not good, etc.

Woman, 25-29, town, does not cycle for any purpose

More bike lanes in cities but even more in rural areas.

Woman, 20-24, village, rare cyclist for transport, leisure and other daily movements

More bicycle lanes, for God's sake!

Man, 20-24, metropolis, usual cyclist for transport and occasional for other purposes

Not needed

Spending money on cycling lanes and segregating bicycles from other traffic is not the solution to city cycling mobility. Bicycle should be included as a vehicle on the road.

Man, 20-24, metropolis, rare cyclist for exercise purposes

I think bicycle lanes are not the solution. If one wants to encourage the use of the bike in the city, the use of cars should be limited. That's it. Bicycle lanes not only do not remove any cars but also place all the bikes together in one narrow area.

Man, 20-24, metropolis, frequent cyclist for transport and exercise purposes

Does not = never/almost never; Rare = 1 to 3 days a month: Occasional = 1 day a week; Frequent = 2 to 4 days a week; Usual = more than 4 days a week.

Village (<10 000 inhabit); Town (10 000 – 100 000 inhabit); City (100 000 – 500 000 inhabit); Metropolis (>500 000 inhabit).

I do not know in the rest of Spain... I ride in Madrid, where there is lack of segregated bicycle lanes. I think that simply riding in the centre of the road and being predictable, like other users (e.g. motorbikes), is much more interesting and safe that having exclusive lanes for bicycles. Good luck with the thesis!

Man, 35-39, metropolis, frequent cyclist for exercise and leisure purposes

Riding in the centre of the road in quiet streets (at the expense of modifying my route at some points) is my favourite option.

Woman, 40-49, metropolis, usual cyclist for transport purposes

The only bicycle lanes that I like are those shared with public transport. I do not like being pushed aside.

Woman, 50-60, city, rare cyclist for leisure purposes

Personally, I feel safe sharing the bus lane with the vehicles (buses, taxis and motorcycles) but there are people who are not able to follow the speed of the vehicles.

Man, 20-24, city, frequent cyclist for leisure purposes

Streets for bicycles and lanes for cars, not the other way around. Reorganization of space works better than building more bike lanes.

Woman, 30-34, town, usual cyclist for transport and other daily movements

Road safety education

We need more bicycle lanes and a good road safety education from an early age.

Woman, 30-34, town, rare cyclist for exercise purposes

I think infrastructures are being improved. However, pedestrians and drivers of motor vehicles must be educated as well.

Man, 40-49, city, usual cyclist for leisure purposes

Road safety education is very important!

Woman, 40-49, city, rare cyclist for leisure purposes

People need to be more cautious when circulating on roads.

Man, 35-39, town, does not cycle for any purpose

Does not = never/almost never; Rare = 1 to 3 days a month: Occasional = 1 day a week; Frequent = 2 to 4 days a week; Usual = more than 4 days a week.
Village (<10 000 inhabit); Town (10 000 – 100 000 inhabit); City (100 000 – 500 000 inhabit); Metropolis (>500 000 inhabit).

Parking spaces

Much safer bicycle parking should be installed. Assuring bicycles from being stolen. Secure parking is a very important factor for people who ride.

Man, 20-24, town, rare cyclist for exercise and leisure purposes

Secure parking is fundamental to avoid theft.

Man, 25-29, town, frequent cyclist for transport purposes

Bike theft problems when parking!

Woman, 35-39, village, frequent cyclist for exercise purposes

More bike lanes but mostly adequate parking places.

Man, >60, town, rare cyclist for all purposes

Car limitation measures

The city should be for bicycles, pedestrians and public transport. I think the use of the car should be limited. Cars in the city are equivalent to noise, air pollution... They also increase the time of other vehicles (e. g. buses), which is totally unsustainable.
Regarding the gender perspective, I have noticed a certain 'aggressiveness' from male cyclists. However, in general terms, the use of the bike gives me a greater sense of empowerment compared to my displacements on foot.

Woman, 25-29, metropolis, frequent cyclist for transport purposes

Limiting the speed in the cities (30 km/h). It is very important to lower the levels of pollution and increase the use of the bicycle!

Man, 40-49, city, usual cyclist for transport, leisure and other daily movements

A greater reduction in motor traffic and reduction of speed is required.

Man, 40-49, village, frequent cyclist for transport and other daily movements

Bicycles on the road while limiting speeds for cars (30km/h). Bike lanes only for children and initiation. The eco-mobility is not solved by removing space from the pedestrian, space must be taken from the cars.

Man, 40-49, city, occasional cyclist for all purposes

Does not = never/almost never; Rare = 1 to 3 days a month: Occasional = 1 day a week; Frequent = 2 to 4 days a week; Usual = more than 4 days a week.
Village (<10 000 inhabit); Town (10 000 – 100 000 inhabit); City (100 000 – 500 000 inhabit); Metropolis (>500 000 inhabit).

It is necessary that the speed is limited to 30km/h in the city to ride safely.

Woman, 40-49, metropolis, usual cyclist for transport and other daily movements

Limit the use of private vehicles!

Man, 50-60, town, rare cyclist for all purposes

<u>More promotion needed</u>

More awareness about urban use of the bicycles, in general.

Woman, 30-34, metropolis, frequent cyclist for exercise purposes

There is lack of education and policies to promote bicycle use in cities.

Woman, 20-24, metropolis, usual cyclist for transport purposes and frequent cyclist for leisure and other daily movements

Improvements should be made to promote the use of this transport (bike).

Woman, 15-19, town, frequent cyclist for exercise purposes

Bicycles should be used more.

Man, 20-24, metropolis, rare cyclist for transport purposes

I think my municipality has perfect conditions for bicycle usage. However, in my opinion, politicians are not interested in promoting it. We are very far from the rest of Europe in terms of cycling. Thank you very much for this survey and good luck in your thesis!

Woman, >60, town, frequent cyclist for leisure purposes

If people were more aware of the benefits from using the bicycle, they would use them more.

Man, 20-24, village, frequent cyclist for leisure purposes

It would be great to have good policies that promote the use of bicycles.

Man, 50-60, city, rare cyclist for exercise purposes

Use of bicycles must be encouraged!

Man, <15, village, occasional cyclist for exercise and leisure purposes

The use of bicycles is not widespread habit in Spain. It is a problem of conscience.

Woman, 30-34, village, does not cycle for any purpose

Does not = never/almost never; Rare = 1 to 3 days a month: Occasional = 1 day a week; Frequent = 2 to 4 days a week; Usual = more than 4 days a week.

Village (<10 000 inhabit); Town (10 000 – 100 000 inhabit); City (100 000 – 500 000 inhabit); Metropolis (>500 000 inhabit).

Good conditions in general are needed to encourage the use of the bike.

Woman, 40-49, village, does not cycle for any purpose

Bicycle use has to be promoted!

Man, 25-29, city, occasional cyclist for transport, exercise and leisure purposes

I think the use of bicycles needs to be promoted in Spain.

Woman, 40-49, metropolis, rare cyclist for exercise and leisure purposes

It is necessary to promote the use of alternative means of transport. Not only the bicycle. Kick scooters and public transport are essential.

Man, 30-34, city, usual cyclist for transport, leisure and other daily movements

We are very far regarding in terms of bicycle usage compared to the rest of Europe. It is a shame.

Woman, 35-39, town, frequent cyclist for all purposes

Interesting survey! We are far from having a proper cycling lane system in Galicia. We need more information and more resources to improve it.

Woman, 50-60, city, rare cyclist for exercise purposes

More promotion is needed.

Man, 50-60, city, usual cyclist for transport and other daily movements

There should be higher road safety education in schools. The speed in cities should be reduced to 30 km/h and intermodality should be facilitated more on trains and buses.

Man, 35-39, city, frequent cyclist for transport purposes

I think that in Spain there is no awareness of the use of the bike as a means of transport. But, in my opinion, the solution is to promote its use among the youngest!

Woman, 40-49, city, does not cycle for any purpose

Encourage yourself to use it.

Man, 50-60, town, rare cyclist for leisure purposes

More information about the benefits of cycling. More promotion in general.

Man, 40-49, town, frequent cyclist for exercise purposes

Does not = never/almost never; Rare = 1 to 3 days a month: Occasional = 1 day a week; Frequent = 2 to 4 days a week; Usual = more than 4 days a week.

Village (<10 000 inhabit); Town (10 000 – 100 000 inhabit); City (100 000 – 500 000 inhabit); Metropolis (>500 000 inhabit).

Public investment is necessary to change Spanish bad habits in bicycle usage.

Man, 50-60, village, rare cyclist for leisure purposes

Environmental concerns

It is very important to raise awareness in bicycles and public transport usage. It is good for our health and it is necessary to take care of the environment at the same time! Global warming is happening now!

Woman, 40-49, town, frequent cyclist for exercise purposes and occasional cyclist for transport purposes

We have to care more about the environment! It is urgent!!

Woman, 25-29, village, rare cyclist for exercise and leisure purposes

Spain needs a huge investment in cycling infrastructures. Even more to avoid environmental damage! It may be an expensive investment, but it is very necessary for the ecological well-being.

Man, 15-19, town, does not cycle for any purpose

We have to use the bike more. We would be healthier and happier and it is good for the environment.

Man, 30-34, metropolis, occasional cyclist for transport purposes

I think it's very important to cycle for environmental reasons. Or at least, we should try to use the bus more.

Woman, 15-19, town, rare cyclist for exercise purposes

Safety concerns

There are still lots of drivers that seem to be bother by having bicycles on the road!

Man, 25-29, city, does not cycle for any purpose

It is important to have more bike lanes and to encourage the use of bicycles as a means of transport. However, cyclists need to feel secure first for them to be willing to use it.

Woman, 30-34, village, does not cycle for any purpose

Cars need to respect the meter and a half of MPD security. It saves lives!

Woman, 20-24, village, rare cyclist for leisure

Does not = never/almost never; Rare = 1 to 3 days a month: Occasional = 1 day a week; Frequent = 2 to 4 days a week; Usual = more than 4 days a week.

Village (<10 000 inhabit); Town (10 000 – 100 000 inhabit); City (100 000 – 500 000 inhabit); Metropolis (>500 000 inhabit).

It is essential to improve the facilities in a way that ensure safe rides for cyclists.

Man, 50-60, town, usual cyclist for exercise purposes

More respect for cyclists is needed!

Man, 35-39, town, frequent cyclist for exercise and leisure purposes

I do not feel safe when riding. We do not want to be brave, but free to exercise!

Woman, 60-50, metropolis, rare cyclist for leisure, transport and other daily movements

High speed and low overtaking distances by motor vehicles is what I find most unpleasant when riding.

Man, 40-49, metropolis, usual cyclist for transport purposes

It is necessary that drivers of motor vehicles are more aware of cyclists. For many people we are a nuisance!

Woman, 35-39, city, frequent cyclist for exercise and leisure purposes

Bike lanes are sometimes not very well designed. Some of them are very dangerous. I have commuted several times by bike. It is a 9 km way, but it takes one hour. On my way, there are light poles in the middle of the cycling lane. The bike lane is not well marked and visibility is simply not good in many sections. I risk getting a fine for riding on the sidewalks in some sections along my way. I get to my workplace but I do not have showers or a locker. As a worker in the University of A Coruña, I have where to keep my helmet and my backpack but if I were a student I would not. As a result, I do not see the bike as an alternative transport.

More road safety education is needed. I would come to work by bike almost every day if I had a decent lane and could do the route in 40 minutes instead of an hour.

Woman, 40-49, town, frequent cyclist for exercise and other daily movements

People need to know about road safety and respect cyclists.

Man, 20-24, town, occasional cyclist for exercise purposes

More controls in the safety overtaking distance!

Man, 40-49, village, frequent cyclist for exercise purposes

Bicycle needs to be a safe means of transportation.

Woman, 50-60, town, rare cyclist for other daily movements

Does not = never/almost never; Rare = 1 to 3 days a month: Occasional = 1 day a week; Frequent = 2 to 4 days a week; Usual = more than 4 days a week.

Village (<10 000 inhabit); Town (10 000 – 100 000 inhabit); City (100 000 – 500 000 inhabit); Metropolis (>500 000 inhabit).

I would ride more if the cycling lanes in my area were less dangerous.

Woman, 40-49, village, does not cycle for any purpose

I have to ride with my children and I feel insecure about the traffic. This prevents me from riding more.

Woman, 40-49, village, does not cycle for any purpose

More emphasis should be given to cycling safely.

Woman, 50-60, city, usual cyclist for all purposes

I fear travelling alone by bike on long routes. Otherwise, I would ride much more than I do. I am also worried about leaving my bike on the street because many bicycle are stolen.

Woman, 40-49, metropolis, occasional cyclist for exercise and leisure purposes

It is very important that bicycle users also respect traffic regulations.

Man, 50-60, city, rare cyclist for exercise purposes

I am looking forward to the day I can ride by bike, with my children to go to school. For a child of 7 years, the city by bicycle is a highly insecure territory.

Man, 35-39, city, frequent cyclist for transport, leisure and other daily movements

I think cyclists should have more rights. Few cars respect us!

Man, 15-19, village, frequent cyclist for exercise and leisure purposes

Intermodality

It would be interesting to promote the existing services to rent bicycles (such as 'Bicing' in Barcelona) from the nearby municipalities. For example, with fare integration between renting services. So that we could avoid the inconvenience of having to carry your own bicycle on the train.

Good luck with your thesis!

Man, 25-29, city, usual cyclist for transport purposes

Very few people complain about the extra money that costs carrying the bike on trains but it is very inconvenient!

Woman, >60, metropolis, rare cyclist for all purposes

Does not = never/almost never; Rare = 1 to 3 days a month: Occasional = 1 day a week; Frequent = 2 to 4 days a week; Usual = more than 4 days a week.

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In live near Madrid, in a town of 3000 inhabitants. There, the roads are two lane-streets and the speed of the cars makes trips between municipalities dangerous.

Woman, 40-49, metropolis, rare cyclist for transport and leisure purposes

More cycling paths, free public city bikes and more stations to pump air. Also, instead of needing to pay more on the train for carrying a bike, it should be free or we should have a discount because we are doing something good for the environment!!

Woman, 25-29, metropolis, frequent cyclist for transport, leisure and other daily movements

Good bike lanes that encourage bicycle usage and improve communication within districts.

Woman, 25-29, town, rare cyclist for exercise and leisure purposes

Wide lanes are needed, with continuity between towns, municipalities, cities, etc.

Woman, 40-49, town, rare cyclist for exercise purposes

Other suggestions

I use it to train. Drivers of cars tend to get angry when there is a bike lane and we do not use it, but we cannot go fast on the lane. It is a mess!

Woman, 40-49, town, rare cyclist for exercise purposes

Ease bicycle mobility with children. It is my biggest limitation! I have two small girls and I need an additional tool to carry both of them at the same time. However, I am not allowed to use those tools in my city. Thus, I do not use the bicycle as much as I did before.

Man, 35-39, city, frequent cyclist for transport and other daily movements

Need of registration (license number for bicycles) to travel through interurban roads.

Man, 35-39, city, rare cyclist for leisure purposes

Coexistence with kick scooters. The latter seems to be the greatest competitor of the bike.

Man, 35-39, town, rare cyclist for exercise and leisure purposes

I wish people stop looking at us (cyclist) as if we were 'poor' by going by bike for transport reasons.

Woman, 50-60, village, usual cyclist for transport and other daily movements

Does not = never/almost never; Rare = 1 to 3 days a month: Occasional = 1 day a week; Frequent = 2 to 4 days a week; Usual = more than 4 days a week.

Village (<10 000 inhabit); Town (10 000 – 100 000 inhabit); City (100 000 – 500 000 inhabit); Metropolis (>500 000 inhabit).

Before having the second baby, I used to ride a lot with the baby chair. Now, I cannot carry both of them at the same time…

Woman, 35-39, town, does not cycle for any purpose

Even today, there are men who feel entitled to say nonsense comments mocking women who ride bicycles. I have suffered it and it is very tiresome.

Woman, 35-39, city, does not cycle for any purpose

City bikes should be for free. It is sometimes too complicated because you have to be registered. I personally do not want to register if I am holidays somewhere.

Man, 50-60, village, usual cyclist for transport purposes

There should be more services to rent public bicycles.

Woman, 20-24, town, does not cycle for any purpose

It would be interesting to address how the way of riding of some cyclists influences the perception and choice of riding of others. For example, aggressive riders or high speed may lead to see cycling as a dangerous activity.

Man, 20-24, metropolis, frequent cyclist for exercise purposes

Does not = never/almost never; Rare = 1 to 3 days a month: Occasional = 1 day a week; Frequent = 2 to 4 days a week; Usual = more than 4 days a week.

Village (<10 000 inhabit); Town (10 000 – 100 000 inhabit); City (100 000 – 500 000 inhabit); Metropolis (>500 000 inhabit).

2. Regarding the survey itself

The survey is very cool! But the questions about the intersections and sections of roads are a bit difficult to answer.

Man, 25-29, metropolis, occasional cyclist for transport purposes

It would also be good to ask a question about the weekly or monthly mileage. That way, relevance of the information would be more in hand. It is not the same to cycle 10 or 100 km per week.

Man, 20-24, village, frequent cyclist for transport purposes

The survey is very long.

Woman, 20-24, metropolis, frequent cyclist for exercise purposes

I would have asked some questions related to whether you would be willing to leave the car if there were tax incentives for km travelled to / from your workplace or VAT elimination in case you purchased a bike for that purpose.

Man, 40-49, metropolis, occasional cyclist for transport, exercise and leisure purposes.

In the first drawings, it is not clear whether it is urban or interurban. The situation is very different if it is a residential street or a road at 90 km/h.

Man, 40-49, metropolis, usual for transport purposes

It takes longer than 5 minutes.

Man, 40-49, town, occasional cyclist for exercise

In the question about the use of the bicycle in childhood, what I would have answered is that I used it on vacation or something like that.

Woman, 30-34, city, rare cyclist for leisure and other daily movements

I believe that this survey does not correctly separate the bike ride with exercise motivations and for commuting purposes.

Woman, 30-34, city, rare cyclist for exercise purposes

Too long and redundant.

Man, 40-49, village, does not cycle for any purpose

Does not = never/almost never; Rare = 1 to 3 days a month: Occasional = 1 day a week; Frequent = 2 to 4 days a week; Usual = more than 4 days a week.

Village (<10 000 inhabit); Town (10 000 – 100 000 inhabit); City (100 000 – 500 000 inhabit); Metropolis (>500 000 inhabit).

Thanks for doing this survey! Hope my answer helps you for your thesis!

Woman, 40-49, city, rare cyclist for transport and leisure purposes

Very good initiative.

Woman, 30-34, town, frequent cyclist for exercise purposes

In my opinion, the feeling of driving on a sidewalk (which otherwise is forbidden) has nothing to do with driving on a dirt track.

Man, 30-34, city, rare cyclist for exercise and leisure purposes

In gender options, transgender is missing.

Man, 50-60, city, usual cyclist for transport and leisure purposes

Very good questionnaire!

Woman, >60, town, rare cyclist for transport purposes

Thank you very much for the survey, I would like to know the results once they are published!

Man, 35-39, city, usual cyclist for transport and frequent cyclist for leisure and other movements

Does not = never/almost never; Rare = 1 to 3 days a month: Occasional = 1 day a week; Frequent = 2 to 4 days a week; Usual = more than 4 days a week.

Village (<10 000 inhabit); Town (10 000 – 100 000 inhabit); City (100 000 – 500 000 inhabit); Metropolis (>500 000 inhabit).

3. Other comments

I do not think my answers are relevant. I do not consider the bike as a means of transport but simply a way of doing exercise. I use it a lot but never in the city.

Man, 25-29, village, rare cyclist for exercise purposes

There are great differences in the Spanish territory. I think it is difficult to reach a uniform conclusion. For example, the case of A Coruña (where the bike lane is conspicuous by its absence) is very different from Seville (where there is bike lane in almost all the streets). Not only by the existence or non-existence of infrastructure but also because of the climate, orography, etc.

Man, 25-29, city, does not cycle for any purpose

I do not see any gender differences in cycling. Maybe it has something to do with being born in Germany. I came to Spain when I was 27 years. In my country, women ride a lot.

Woman, 40-49, metropolis, frequent cyclist for transport purposes

Since I do not know how to ride a bike, I have answered this survey thinking about what I would like in case I knew how to use it.

Woman, >60, city, does not cycle for any purpose

I really do not like riding. Thus, I believe my answers are not relevant for this study.

Woman, 50-60, village, rare cyclist for exercise purposes

Does not = never/almost never; Rare = 1 to 3 days a month: Occasional = 1 day a week; Frequent = 2 to 4 days a week; Usual = more than 4 days a week.

Village (<10 000 inhabit); Town (10 000 – 100 000 inhabit); City (100 000 – 500 000 inhabit); Metropolis (>500 000 inhabit).