

Article

# Investigating the Link between Transport Sustainability and the Representation of Women in Swedish Local Committees

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**Abstract:** There are large discrepancies in the transport sector along gender lines in travel patterns and means of transportation used, but also in attitudes and norms among citizens, planners and decision-makers, with women generally more positive towards measures involving the lowering CO<sub>2</sub> emissions. At the same time, the number of women involved in transport-related decisions is low. This is a problem for gender equality but possibly also for sustainability. A careful review of previous studies indicated a lack of analyses on the subject based on quantitative data at the local level. We investigated a possible link between women's presence in local policymaking and more sustainable transport policies, and whether it is possible to capture such an effect. The main contribution of this paper is a methodological approach in which, besides generating unique data on representation in municipalities (confirming men's dominance, specifically in transport policymaking), possibilities for quantitatively measuring gender and the level of sustainability in transport planning are discussed and tested. Challenges in collecting relevant data and analyzing possible covariances in the data set are discussed and presented as well as suggestions for further investigations into the possible link between gender and sustainable transport performance.

**Keywords:** gender; mobility; passenger transport; female representation; critical mass

## 1. Introduction

Overall CO<sub>2</sub> emissions are decreasing in the EU, but greenhouse gas emissions from transport have increased in recent years. Transport represents almost a quarter of Europe's total greenhouse gas emissions, and the transport sector has not seen the same gradual decline as others [1]. Emissions started to decrease in 2007 but then increased ([ec.europa.eu/clima/policies/transport-en](http://ec.europa.eu/clima/policies/transport-en)). According to the Swedish Transport Administration [2], the Swedish transport sector contributes significantly to this problem, and the Swedish Parliament recently adopted (15 June 2017) a climate act stipulating that emissions from the transport sector must fall by 70% by 2030, with 2010 as the base year [3]. Most of these emissions are from passenger transport generated by individual travel.

To tackle climate emissions, there is a need to promote sustainable transport, different infrastructure planning and investments, and new technical solutions [4–6] and through changed transport behavior [7–9]. These changes are necessary for an environmentally sustainable transport sector. There is also a need to support measures supporting less and more efficient freight transports [10].

Sustainability is associated with an ecosystem view, but a holistic perspective on transport planning, social, economic and governance systems also needs to be applied, and the time horizon should include

the long-term and future generations for intergenerational equity. Cornet and Gudmundsson [11], suggested that a key feature of sustainable transport planning is the development of sustainable solutions accepted by a majority of the population.

Many factors affect the overall performance of the transport sector, not least the planning and supply of infrastructure [12–14]. Decisions on targets and intentions for planning that are in regards to or affect the transport system are made on a comprehensive, as well as local, level. The planning process is characterized by a multitude of actors and the interactions between them, both in Sweden [15] and in other countries [16–18].

Efforts to include women in transport planning by recognizing their conditions, values and preferences seems a logical step to counter this. We suggest that gender equality may be relevant to increasing energy efficiency in the transport sector, as there are large discrepancies in the sector along the lines of gender in travel patterns and choice of transportation means, as well as in attitudes and norms among citizens, planners and decision-makers [19–23].

Following this line of literature and assuming that women's presence in policymaking also means that their norms, attitudes and travel behavior could influence policy, gender-equal representation in transport-related decision-making has significant potential to increase the level of sustainability in transport planning by increasing energy efficiency and reducing CO<sub>2</sub> emissions. Based on the results of, for example, Kronsell et al. [19], we started from the hypothesis that, if women were well-represented in policymaking on transport issues, policymaking would also become more sustainable and in line with climate ambitions.

Sweden is known to score highly on gender indexes, such as the EU Gender Equality Index [24], and has gender mainstreaming as a policy strategy for realizing gender equality [25]. In the Swedish transport sector, there is already a recognition of the importance of paying attention to gender aspects [26–28], even though it is not necessarily realized [29]. In Swedish transport policy, social concerns are included in the overall target [30,31], with more specific attention to gender reflected in the functional target that seeks to create accessibility through the design, function and use of the transport system; this should provide everyone with basic access to good quality transportation in everyday life, specifically, “the transport system should respond equally to women's and men's transport needs.” Social concerns are also visible in the considerations target, which stipulates that increased accessibility should be reached in tandem with increased road safety, improved health and improved environmental performance.

The environmental performance of the transport policy relates to the national environmental objectives through its overall goal “to hand over to the next generation a society in which the major environmental problems are solved, without causing increased environmental and health problems outside of Sweden” [30,31]. Gender is not explicit here.

The Swedish Parliament has adopted a vision of zero net emissions of greenhouse gases into the atmosphere in Sweden by 2045 [3]. These targets are to be assured through a transport policy in which emissions must fall by 70% by 2030, with 2010 as the base year. In summary, these general provisions in policy, coupled with the knowledge that Swedish women's carbon emissions from transport are on average lower than men's—mainly due to men having 44% more car mileage [32], mostly for work and business [23]—makes gender analysis highly relevant for the Swedish context.

On the regional/national level, the national Swedish Transport Administration and the regional authorities participate in the overall planning of transport infrastructure by jointly developing long-term infrastructure plans for each region. This is basically a four-year process following the political four-year terms [33]. The orientation of the long-term transport infrastructure planning is established by the government. The local level and local decisions are important, however, both for providing the basis for future decisions for the transport system and by having responsibility for local transport systems. On the local level, the municipalities have the responsibility for establishing and providing current comprehensive plans (land development plans) to provide guidance for decisions on use of land and water areas, which thus also forms the basic conditions for future infrastructure planning on the

national/regional level. The land development plans are an important planning tool but, perhaps more importantly, are an important platform for planners and politicians to gather around to discuss each municipality's future development [34]. The plans, however, are not legally binding. Municipalities decide on urban planning and transport issues, such as local streets, parking, maintenance and measures for sustainable travel. At the same time, measurements of local transport sustainability status indicate that there is variation between the municipalities [35].

Municipal self-government is a principle that is enshrined in the Swedish constitution. The municipalities must comply with the framework set by the parliament and the government, but municipal autonomy gives each municipality the right to make independent decisions and to levy taxes on its inhabitants to be able to carry out its duties.

In this paper, we ask whether there is a link between women's presence in policymaking and sustainable transport policy in line with climate ambitions and whether it is possible to capture such an effect empirically, in the same way as research on the relationship between gendered influence on firms' sustainability performance has done [36,37]. Our research design emerged from a qualitative study that provided the conceptual material and inspiration for our methodology. In a systematic literature review, using keyword searches (different varieties of keywords were used to search abstracts, beginning with "gender/sustainable/transport"; to reduce the number of hits to a manageable size, the search was refined with other key words, such as "climate", "energy efficiency", "equal representation" and "women". A total of 63 articles, together with already known works from previous research, formed the basis for the review) in Scopus, Web of Science and Academic Search Complete, where we searched for scientific articles on representation in relation to climate issues and sustainable transport. These articles were analyzed specifically for how they approached and studied the relationship between gender, climate and transportation; we found that the link has been explored previously, but with ambiguous results. A careful review of previous studies also indicated a lack of analyses of gender influence based on quantitative data and at the local level.

The main contribution of this paper is thus a methodological approach in which, besides generating unique data on representation in municipalities (confirming men's dominance in transport policymaking), possibilities for quantitatively measuring gender effects and the level of sustainability in transport planning are discussed and tested. Challenges in analyzing possible covariances in the data set are also discussed and presented.

Even though there are sustainability measures directed to freight transports (especially in the urban area), this paper mainly deals with sustainability within the passenger transport system due to the general focus within policymaking on measures and strategies directed to this area of transport. Analyses of policies directed to freight transports are also highly relevant for improving sustainability, but this is not within the scope of this study.

This article begins with an overview of previous scholarship on gender and sustainable transport—a crucial foundation for our investigation of the relationship between equal representation in transport policymaking and the level of sustainability in transport planning, both conceptually and methodologically. Next, we focus on representation and discuss the data on representation as one of the variables in our quantitative analysis. This gives an overall view of women's representation and how it has changed over time. The analysis is based on unique new data on representation assembled for this study. In the section that follows, we present our search for adequate and available data to serve as indicators (indexes) for sustainable transport at the local level. Next, we present the results of our empirical analysis of a possible relationship between gender representation in decision-making in Swedish municipal transport-related committees and the level of sustainability in transport planning as expressed in our indexes. Finally, we discuss the results and their implications for accommodating climate and sustainability targets.

## 2. Conceptual and Methodological Concerns

### 2.1. Literature Review

In search of a suitable way to investigate gender-equal representation in transport policymaking and the link to the level of sustainability in transport planning, we turned to studies on gender representation, gender perspectives on sustainable mobility and gender in relation to climate and sustainability more generally to provide theoretical and methodological insights into our study. Many of the articles on gender and sustainable transport in our review focused, however, either on the relationship between women and transport behavior or on the relationship between women and attitudes towards sustainability and transport choices. The scholarship was nevertheless suggestive of the potential for a more extensive representation of women in policymaking and illustrative of what we might expect with a critical mass of women involved in transport policymaking and what kind of difference women might make once they have been included in the polity. Also, we could not find any literature specifically focusing on these issues at the local level.

The literature on behavior and attitudes shows that transport behavior or mobility patterns are gendered in a way that also suggests they are more sustainable. Most studies that analyze gendered transport behavior are conducted through quantitative methods in which the sex variable is included in a regression analysis—often together with other socio-demographic variables—to analyze transport modal choices and their implications for carbon emissions and sustainability. Although these studies are not global, they emerge from various locations in the world [38–50]. The studies do confirm the gendered nature of transport choices. Furthermore, they clearly illustrate that gender does not impact in a universal way, but that the geographic, social and cultural context also influence mobility patterns. Our study is on the Swedish case, and, therefore, studies that have analyzed mobility patterns in Sweden [19,26,51–53], are of relevance. They largely concur with research in the field in other contexts as they conclude that women’s mobility is less car-dependent and leads to lower CO<sub>2</sub> emissions than men’s. Women’s transport behavior can be expected to have significance, as gendered experiences of mobility favor women’s contributions to sustainable transport policymaking.

Women’s attitudes can be expected to influence policymaking. A quantitative study by Sundström and McCright [54] focused on the link between gender and environmental attitudes in Sweden. It looked at four levels of the polity and demonstrated a significant gender gap regarding the degree of environmental concern among the citizens, among the municipal councils and at the regional level. Only in the national parliament was the difference not statistically significant [54]. Various surveys have shown that women in the EU and the US are more concerned about climate issues than men [55–59]. Women are also more in favor of implementing measures that could improve the situation and state that they are more inclined to change their own behavior. This is in accordance with Swedish Environmental Protection Agency’s surveys on climate change [60–62], which have demonstrated gendered differences in knowledge and attitudes towards climate change [23]. More specifically, women were found to be more concerned with both the environment and with the needs of other users, especially the elderly, the disabled, bicyclists and pedestrians [53,63,64]. Questions related to mobility and transport behavior also show gender differences, as women put more emphasis on environmental and traffic safety issues than men [52,65]. These values match what would be expected from a sustainable transport system. Studies conducted in other geographical areas highlight that the gender variable is significant regarding attitudes and the propensity to want to change policies and behavior, but also that gender interacts and is co-dependent with other socio-demographic variables [66–70]. These studies on the gender differentials in behavior and attitudes suggest that, if women were equally represented in policymaking, the gender differentials would be carried over to impact policymaking.

Representation, or the lack thereof, is a crucial topic in gender studies on democracy; if gender representation is imbalanced in democratic institutions, it is a sign of an ill-functioning democracy [71]. Policymaking is considered democratic when women and men enjoy equal representation and when

women can influence policymaking to the same degree as men. To explore women's involvement in policymaking, scholars have developed two concepts: descriptive and substantive representation.

Descriptive representation refers to the number of male and female bodies present in institutions where political decisions are made [72], and the democratic quality of the polity clearly improves with a larger community of female politicians and decision-makers [73]. Substantive representation means that women's presence is expected to have an impact. The concept of "critical mass" qualifies this notion as women's presence must be of a certain magnitude to have any substantive effect on policies [74]. Drude Dahlerup argued that at least 40% is needed to influence policymaking [75,76]. Studies on descriptive representation have centered on issues like reproductive rights or violence against women and not on policymaking for sustainable climate and transport policy. Using this terminology, our analysis was concerned with how descriptive and substantive representation are linked, and we expected a critical mass of women involved in transport policymaking to lead to sustainable outcomes.

However, any assumption that women's policymaking is different from that of men might be premature, as the evidence is far from conclusive [71]. The link is more probabilistic than deterministic [72], and, when found, such linkages are not straightforward but complex and multifaceted [77,78]. A strict focus on representation might under-estimate internal power dynamics in, and the normative context of, political institutions [79]. However, Nagel [80] suggested turning the argument around—that the critical mass of male policymakers has had a specific impact on climate change: "The policies that shape local, national and international responses to climate change reflect the gendered power, privilege and preoccupations of mostly male policymakers around the world" [80] (p. 4), thereby suggesting that there is a link between the descriptive representation of (mostly) men in policymaking and the substantive outcomes in terms of policy. This does not rule out that gender power as reflected in male representation is strengthened by institutional norms.

Similar arguments—although not necessarily employing the above concepts—can be found in the literature on gender and transport sustainability [81–90]. These studies have argued for the need for women's perspectives in climate and transport policymaking because, when it is lacking, women's use and experience of the transport system will not influence planning and policymaking.

Only a few studies have explicitly addressed the relationship between women's representation and sustainability. While many quantitative studies have used gender or sex as a variable to study women's travel patterns, attitudes or political representation, they have not linked this to sustainability. Three studies have explored this link on the national level; two of these were quantitative and used regression analysis, and both found a positive correlation between women's representation and sustainable outcomes, defined as environmental treaties and carbon emissions. In a global study, Norgaard and York [91] assessed the relationship between women's participation in parliament and the rate of environmental treaty ratification and showed that states with a higher proportion of women's representation are more likely to sign environmental treaties, thus suggesting that improving gender equity also supports environmental reforms [91]. In another article, Ergas and York [92] related women's representation to a state's climate emissions. When they assessed the effects of women's political status—using an index based on a combination of seats in parliament, year of women's suffrage and percentage of women in ministries—on per-capita World Bank CO<sub>2</sub> emissions data, they found that, when women's political status is higher, per-capita CO<sub>2</sub> emissions are lower. Our research puzzle found a starting point in these findings.

However, contrary results were found in the third study, which was based on qualitative data from Scandinavian climate policymaking institutions. In that study, equal representation did *not* result in any visible effects on the content of climate policy documents nor on institutional practices [93,94]. Data on representation of the percentage of women in both political and administrative climate institutions (such as Environmental ministries and Environment, Transport and Energy Agencies in the cases of Norway, Denmark and Sweden. In the case of the EU Commission, representation in the EU Climate DG was analysed) where policies are crafted was studied. Effects on policy were assumed to be



traceable, through text analysis and that gender aspects would in some way become visible in climate policy documents. They found that, despite equal representation, there was a complete silence on gender in policy texts. This lack was verified in interviews with policy makers who lacked insights on whether and how gender issues have relevance for climate change.

## 2.2. Input to the Study Outline

Overall, as became apparent from the literature review, the hypothesis that women's representation in policymaking will have effects leading to more sustainable transport has not been fully substantiated. Our findings also indicate that the link between gender and environmental sustainability has had little scholarly attention (in line with [95] Wilson & Chu, 2019). In particular, we have not found any specific research publications investigating the link between local decision-making and sustainability action, and this is where the current study contributes, with an analysis in the Swedish context.

Previous studies on representation and transport sustainability [91–94] have either used statistics on female representation in political bodies alone or female representation in political and administrative bodies together. The work of Ergas and York [92] also assessed the effects of women's political status, including information on the year of women's suffrage, thereby acknowledging that the share of female bodies may not mirror prevailing power relations and that various organizational positions, such as being a chairperson, have influence. Political party affiliation may be relevant, for instance, parties with leftist ideologies with egalitarian values favor equal representation [96]. This effect has diminished over time as equality policies have become more common. In the 2014 Swedish elections, all parties used some form of quota [97].

With an identified lack of other studies on local decision-making and sustainable transport, we proceeded with a focus on representation of politicians. Party affiliation may also be regarded as less relevant at the municipal level in Sweden, where there are often alliances between parties and voting collaborations to a greater degree than at the national level [98]. There are even committees, boards and councils that are shared between two or three municipalities, one example of which is the municipalities of Askersund, Laxå and Lekeberg, which share committees for IT, building and the environment.

## 3. Trends in Women's Representation

### 3.1. Municipal Organisation in Sweden

In Sweden, the council is the local parliament directly elected by citizens. The municipal board is the local government, often based on a coalition between the parties with the most seats. Boards and councils are responsible for the broader political decisions in the municipalities, and the council decides which committees should be present in the municipality. The council also appoints elected representatives as regular members and substitutes for the municipal board and the committees based on agreements between parties.

Since the municipalities themselves decide which committees they want, the organizational structure varies between municipalities. A committee receives its mission from the council and is responsible for a specific area. The committees are responsible for the day-to-day operations of the municipality, preparing matters to be decided by the council and carrying out decisions made by the council. On minor issues, the committees have decision-making power [99,100].

### 3.2. Data on Representation

As transport-related committees are the bodies closest to transport decisions that are important for sustainability in the transport system, we systematically gathered new, unique data on women's representation in them for all municipalities in Sweden for 2003–2017. To observe changes over time and to give an overall view of women's representation in municipalities, we also assembled data on women's representation in the boards and councils.

The main source for statistics on women’s representation in municipal councils and boards was Statistics Sweden, since municipalities are obliged to report the gender distribution of municipal bodies after each election. From this source, data on gender distribution was collected for 2003, 2007, 2011 and 2015. Additional data on representation for boards and councils for 2017 (representation at the time of data collection) was gathered from municipal websites. For some municipalities, this information was not available for the board and/or council at the time of the study (see number of observations in Table 1).

**Table 1.** Statistics for women’s representation (regular members) in municipal boards and councils.

	Board, Years					Council, Years				
	2003	2007	2011	2015	2017	2003	2007	2011	2015	2017
Average	0.31	0.33	0.36	0.36	0.34	0.42	0.42	0.43	0.43	0.42
Stdv	0.18	0.18	0.20	0.20	0.21	0.05	0.06	0.05	0.05	0.06
Max	0.82	0.82	0.90	0.91	1.00	0.55	0.55	0.56	0.60	0.62
Min	0	0	0	0	0	0.27	0.23	0.26	0.26	0.22
N	289	289	289	289	282	289	289	289	289	278

Since the focus of the study was on transport-related decisions, and we wanted to collect data on the representation of women in the municipal committees that are responsible for transport decisions, information on the areas of responsibility for the municipal committees was collected from their websites. There were some difficulties in obtaining this data, as committee names, organization and division of responsibilities varies between municipalities. Some transport committees are shared between municipalities or do not exist at all, with transport-related decisions handled by the municipal board; in some cases, there was no available information on the committee members. Based on the information available from the municipalities’ websites, the relevant committees for 2017 were identified. This information was also applied to identify the relevant committees for previous years. However, for many municipalities, it was not possible to track the same committee over time due to changes in organization, name, etc. This resulted in a reduced number of municipalities for the first years of the studied period (see number of observations in Table 2).

**Table 2.** Statistics for women’s representation (regular members) in municipal transport-related committees.

	Committee, Years				
	2003	2007	2011	2015	2017
Average	0.22	0.24	0.28	0.28	0.27
Stdv	0.13	0.15	0.14	0.16	0.17
Max	0.60	0.71	0.67	1.00	1.00
Min	0	0	0	0	0
N	118	146	157	228	267

### 3.3. Trends in Women’s Representation

The trends over time indicate a steady, statistically significant increase in women’s representation as regular members in all studied municipal bodies from 2003 to 2011. There was, however, no significant difference in women’s representation from 2011 to 2015. Women’s representation decreased—statistically significantly—from the 2015 election until the current, between-election representation. This is an interesting result, although not further elaborated upon in this paper. During the studied period from 2003 to 2017, the standard deviation of women’s representation also increased, suggesting that there are still some municipalities with low representation of women, while others have increased.

We find it interesting to compare representation in the different municipal bodies. The representation is somewhat higher for boards and councils, but still below what can be considered gender-equal. It is the councils that have the most gender-equal representation, with an average above 40% for all studied years, amounting to what would be considered a critical mass [74,101]. Turning to the committees on transport, we note that women's representation is comparatively low, with averages of less than a third.

That there is a lower gender representation within the transport area is a trend noted overall for both Scandinavian countries [93] and the EU [102]. It suggests that transport is a masculine-coded issue area, neither attracting female politicians nor implicitly working to exclude them. Indeed, the idea that transport is masculine-coded has been suggested in studies that have analyzed difficulties in restricting car use and linked to prevailing masculine norms embedded in the transport sector [20–22]. Johnston et al. [103] also suggested that “public bureaucracies are not gender neutral but rather the domain of masculinity” [103] (p. 537).

#### 4. Representation and Sustainability Outcomes

In this paper, we ask whether there is a link between women's presence in policymaking and sustainable transport policies in line with climate ambitions, and whether it is possible to capture such an effect empirically. In this section, we give a broad description of our search for adequate and available data that can be used. We also present results from the empirical analysis, with the ambition of exploring the possible effect of women's representation in municipalities in Sweden on the level of sustainability in local transport planning.

##### 4.1. Data and Indicators

###### 4.1.1. Sustainability in Transport Planning

To quantitatively capture the level of transport sustainability connected to climate emissions for each municipality, various variables were considered, since transport sustainability has no easily measured indicator. Since car mileage needs to be reduced to reach climate targets, statistics from the Swedish national travel survey on the total number of car kilometers per municipality (or car kilometers per capita) were considered (see Transport Analysis [104] for information on the survey). However, due to limitations in the size of the data set on the local level, these statistics were disregarded. Statistics on the number of car kilometers reported centrally by all companies carrying out motor vehicle inspections were also disregarded because they lacked information for newer cars (there are no inspections for cars aged three years or less), leased cars and cars owned by companies (see Transport Analysis [105] for information).

We therefore experienced problems finding good quality data on sustainability connected to climate emissions (CO<sub>2</sub>) with national coverage. Another alternative considered was analysis of the allocated budget for sustainable transport at the municipal level, but it was deemed impossible to single out this expenditure from the budget for all municipalities. Various “ready-made” indicators of sustainability were also considered, such as “SHIFT” presented in Neergaard et al., [106], which would enable evaluation and ranking of the local work on transport sustainability, and a sustainability index developed by the Swedish organization Aktuell Hållbarhet, which includes various aspects of sustainability, including management of transport, water and energy. However, these were disregarded due to limited coverage of Swedish municipalities—they are often limited to larger municipalities and/or those engaged in transport sustainability measures—or due to the inclusion of variables other than transport sustainability.

In the end, we decided to use specific parts of the survey carried out annually by the organization Aktuell Hållbarhet (index year 2017) and a survey carried out by the National Board of Housing, Building and Planning (BHBP) (survey year 2015). Based on responses to these surveys, we constructed two indexes based on eight questions connected to the presence of sustainable transport planning



documents, strategies and actions (see Table 3). The use of these variables was inspired by Magnusdottir and Kronsell [93,94] and Norgaard and York [91], who suggested that the relationship between women's representation and the level of sustainability in transport planning could be analyzed through documents, strategies and plans. Both surveys we used have a large coverage of Swedish municipalities with a response rate of approximately 90%. The responses used were of two types, describing (1) presence of policies and planning documents and (2) implementation and actions. The analysis of the relationship between representation and sustainability in transport was based on the sum of all eight responses, assuming both equal weighting of each variable, and the sum of responses of each type.

**Table 3.** Questions and response options used for the sustainability indexes, separated by index type.

Type 1: Policy and Planning Documents	Response Options	Survey	Year of Survey
Strategy following Agenda 2030	Yes (2), Partly (1), No (0)	Aktuell Hållbarhet	2017
Environmental goals	Yes (2), Partly (1), No (0)	Aktuell Hållbarhet	2017
Climate goals	Yes (2), Partly (1), No (0)	Aktuell Hållbarhet	2017
Program for sustainable transport	Yes (2), Partly (1), No (0)	Aktuell Hållbarhet	2017
Documents supporting sustainable transport and reduced transport	Yes for all areas (3), Yes partly (2), Work in progress (1), No (0)	BHBP	2015
Type 2: Implementation and Actions	Response options	Survey	Year of survey
Follow-up on climate goals	Yes (2), Partly (1), No (0)	Aktuell Hållbarhet	2017
Economic instruments/actions targeting CO <sub>2</sub> emissions from municipal transport	Yes (2), Partly (1), No (0)	Aktuell Hållbarhet	2017
Actions supporting sustainable transport last two years	Yes (2), No (0)	BHBP	2015

#### 4.1.2. Women's Representation

To study the possible relationship between women's representation and the level of sustainability in transport planning, we considered the time lag between when decisions are made and when the outcome of those decisions can be identified. Some decisions, such as parking restrictions, have an immediate effect on the transport system while others, such as infrastructure investments, have an effect after several years. We based our analysis on women's representation in 2011 and 2015 and its relationship to our sustainability indexes based on information from the years 2015 and 2017.

In the analysis, we used women's representation in 2011 and 2015 in transport-related committees (see Section 3.2), being the bodies closest to transport decisions important for sustainability in the transport system. Combining the municipalities for which information regarding representation in 2011 and 2015 could be found (as presented in Table 1) with the restriction to only include municipalities that answered all the questions that our indexes were based on, the analysis was conducted for a total of 109 municipalities for representation in 2011 and 153 municipalities for 2015.

#### 4.1.3. Other Explanatory Variables

Wide [107] analyzed women's representation at the municipal level in Norway for the period from 1947 to 2007, and its spatial variations. In her analysis, the structural context, including socio-economy, population, population density and gender share (percentage of women in the population), was assumed to have an effect on society's demand for female politicians and the supply of female candidates (i.e., interest of women in engaging in politics). Inspired by Wide [107], we also included information on the structural context for each municipality, with a focus on socioeconomic status, as well as spatial and mobility factors (see Table 4). Our assumption was that these structural context factors are also related to the level of sustainability in transport planning. Information regarding population, population density, degree of densification and gender share, plus a socioeconomic index, was collected at the municipal level, together with the factor most strongly related to mobility: the number of cars per inhabitant [108]. Data from 2015 was used, except for the share of population living in urban areas, for which only data from 2010 was available.

**Table 4.** Explanatory factors considered in the regression analyses besides women’s representation in transport-related committees. Source: Statistics Sweden (2018).

Variable	Mean	Min	Max	Year
Population	39,617	4180	923,520	2015
Population density (inhabitants/1000 km <sup>2</sup> )	146.37	0.3	4934	2015
% Population in urban areas	76.5	31	100	2010
Gender share (% women)	50.0	47.4	51.4	2015
Socioeconomic index	5.5	3	8	2015
Number of cars per 1000 inhabitants	424	200	520	2015

#### 4.2. Methods

Multiple regression analysis was used to study the possible interdependence between the level of sustainability in transport planning and women’s representation on the local level. Regression models were estimated using both types of sustainability indexes (see Table 3) as well as the sum of both indexes as dependent variables and women’s representation in transport-related committees in 2011 and 2015, as independent variables together with additional explanatory variables.

To form an initial overview of the explanatory factors considered in the regression analysis, a correlation analysis was conducted using Pearson’s correlation coefficient. This analysis showed a significant correlation between several of the factors considered as explanatory variables (Table 5). Multiple linear regression models were also estimated that included all explanatory variables considered, besides women’s representation in 2011 and 2015. In the models, all variance inflation factors were larger than 10, suggesting a high degree of multicollinearity and corresponding well to the results of the correlation analysis. This result accords with what was found by Wide [107] and indicates that female representation tends to be higher in municipalities with larger populations and higher population densities. Due to correlations identified between possible explanatory variables, the regression analysis was restricted to one founding explanatory variable besides women’s representation. Population density was ultimately considered the most relevant factor describing the structural context.

**Table 5.** Pearson’s correlation coefficient between variables considered as independent variables in the regression analysis.

	Women’s Representation 2011	Women’s Representation 2015	Population Density	Socioeconomic Index	% of Population in Urban Area	Gender Share	Population	Cars Per 1000 Inhabitants
Women’s representation 2011	1.00							
Women’s representation 2015	0.37 **	1.00						
Population density	0.06	0.12	1.00					
Socioeconomic index	−0.05	−0.09	−0.21 **	1.00				
% of population in urban area	0.01	0.05	0.40 **	−0.25 **	1.00			
Gender share	0.13 *	0.11	0.30 **	−0.49 **	0.53 **	1.00		
Population	0.15 **	0.18 **	0.80 **	−0.16 **	0.34 **	0.32 **	1.00	
Cars per 1,000 inhabitants	−0.14 *	−0.14 *	−0.60 **	0.28 **	−0.48 **	−0.33 **	−0.56 **	1.00

\* Significant at 0.10 level, \*\* Significant at 0.05 level.

In line with Kanter [74], on the need for a critical mass of women in order to influence policies, we also made a separate analysis dividing the data set into committees with and without a critical mass of women. In this segmentation, we used the threshold of 40%, as discussed by Dahlerup and

Freidenvall [76]. Significant differences in sustainability outcomes between these subsets were tested using *t*-statistics.

### 4.3. Results

Through multiple regression analyses, we analyzed whether the level of sustainability in transport planning on the local level (based on sustainability indexes) could be explained by the representation of women in transport-related committees and the population density. The results are presented in Table 6 for women's representation in 2011 and Table 7 for women's representation in 2015. In all regression models, the estimated coefficient for population density were significantly different from zero indicating an influence of population density on the level of transport sustainability whereas the estimated coefficients for women's representation were all insignificant, indicating no significant impact on transport sustainability. For all models estimated, the statistics for goodness of fit generally indicated low explanatory power.

**Table 6.** Estimated coefficients in regression models for sustainability indexes based on information from 2015 and 2017 and women's representation in 2015 in transport-related committees (*p*-values in parentheses).

Independent Variable	Dependent Variables		
	Index Type 1 (Policy)	Index Type 2 (Actions)	Summed Index
Intercept	5.04 (0.00)	3.34 (0.00)	8.38 (0.00)
Population density	0.79 (0.02)	0.40 (0.02)	1.19 (0.00)
Women's representation in committees in 2015	0.23 (0.84)	0.91 (0.17)	1.13 (0.48)
F	4.26	4.28	4.98
Adj R <sup>2</sup>	0.04	0.04	0.05

**Table 7.** Estimated coefficients in regression models for sustainability indexes based on information from 2015 and 2017 and women's representation in 2011 in transport-related committees (*p*-values in parentheses).

Independent Variable	Dependent Variables		
	Index Type 1 (Policy)	Index Type 2 (Actions)	Summed Index
Intercept	5.15 (0.00)	3.33 (0.00)	8.48 (0.00)
Population density	0.69 (0.02)	0.37 (0.03)	1.06 (0.01)
Women's representation in committees in 2011	−0.23 (0.88)	0.95 (0.29)	0.73 (0.74)
F	3.00	3.10	3.45
Adj R <sup>2</sup>	0.03	0.04	0.04

To consider the need for a critical mass of women in order to influence policies, differences in the sustainability indexes were analyzed between committees both with and without a 40% representation of women, see Table 8. There was a possibility that the general low level of women's representation (i.e., relatively few observations with women's representation being 40% or higher) would diminish the likelihood of showing a significant difference in the dataset. For 2011, the number of municipalities with more/less than 40% of women's representation was 27/70. For 2015, the ratio was 34/105.

**Table 8.** *T*-test statistics for differences in sustainability indexes based on information from 2015 and 2017 between municipalities with more than 40% and less than 40% of women's representation in transport-related committees in 2011 and 2015.

Year	Index Type 1 (Policy)	Index Type 2 (Actions)	Summed Index
2011	0.38	0.16	0.06
2015	0.36	0.20	0.16

## 5. Discussion

Although Sweden is considered to be a country with a high representation of women in decision-making bodies [109], the overview in this study indicates very low representation of women in transport-related committees at the municipal level over time (for some committees, none). The representation is somewhat higher for boards, and only the councils can be considered gender-equal. This underrepresentation of women, especially in transport committees, is problematic because the democratic quality of the polity clearly improves when women's representation increases [73]. Whether these conditions have implications for climate ambitions and sustainability in transport planning has been the focus of this study. In search of a suitable way to investigate the relationship between equal representation in transport policymaking and the level of sustainability in transport planning, we conducted a literature review and an empirical analysis.

The literature review suggested that there are reasons to be cautious about assuming a simple link between women's representation in policymaking and the level of sustainability in transport planning. Some studies have argued that there is a relationship between women's representation and sustainable decisions [91,92], whereas others have not found such a relationship [93]. As there are few studies on this link, we decided to test it empirically and specifically at the municipal level, as we could find no similar prior studies. There is also an interest in conducting studies at this level in Sweden, based on organizational structures with well-founded municipal autonomy.

The search for adequate and available data on sustainability to be used for the empirical analysis turned out to be an important contribution of this study. Initially, we planned for the level of sustainability in transport planning to be measured as the number of car kilometers driven in the municipality. However, figures with sufficient quality were lacking at the municipal level nationwide, and we searched for a sustainability index aimed at transport with good coverage and enough resolution at the municipal level. This, too, turned out to be lacking. Instead, we developed our own indexes based on questions mainly reflecting the municipalities' preparation of various planning documents and some actions related to those documents.

When we analyzed the relationship between female representation in decision-making bodies and sustainability outcomes in the transport system, we experienced further difficulties. In the regression analysis, we initially planned to include several structural context factors as additional explanatory variables based on their assumed relationship with the level of sustainability. Variables such as population, population density, degree of densification, gender share (percentage of women in the population), socioeconomic index and number of cars per inhabitant were considered. Most of the structural factors, however, showed a strong correlation both with female representation and between each other (much in the same way as in Wide [107]). This result indicated that higher population densities relate to larger cities, lower car ownership, higher shares of women and a better socio-economy. Hence, in the final regression model (Tables 6 and 7), a single structural factor (population density) was included. The population density was considered the most adequate variable for describing the general structural context, and it was found significant for all regression models estimated. This is not surprising, given that higher population density provides better conditions for sustainable transportation than less densely populated areas. Densely populated municipalities are also likely to be municipalities with larger populations and more tax income, resulting in larger investment budgets (including for sustainable transport).

In the analysis, we also had to decide whether to consider a time lag between decisions and their effects on sustainability. This was done by analyzing the relationship between women's representation in 2011 and 2015 and the various aspects of sustainability based on information from 2015 and 2017. We also discussed whether the causality could be the other way around, i.e. that the share of women in transport committees is dependent on earlier levels of sustainability. A high sustainability outcome would then attract women to politics, thus increasing the share of women later.

In our literature review, we found three studies that explored the link between female representation and sustainability on the national level. Two quantitative studies, Noorgaard and York [91], a UK

study on environmental treaty ratification, and Ergas and York [92], a global study on CO<sub>2</sub> emissions, found positive correlations between women's representation and sustainable outcomes, defined as environmental treaties and carbon emissions, respectively. However, contrary results were found in the study of Magnúsdóttir & Kronsell [93], based on qualitative data from Scandinavian climate policymaking institutions. In that study, equal representation did *not* result in any visible effects on the content of climate policy documents nor on institutional practices.

The result of our quantitative study indicated no significant relationship between our transport sustainability index and women's representation. The notion of critical mass was also considered in the analysis when comparing the sustainability outcome of municipalities with more/less than 40% of women's representation. This analysis also showed no significant differences. However, since there was barely a critical mass of women in transport-related committees mapped in this study, it is not likely that there would be any strong evidence of women's more sustainable decision-making.

Focusing on the result of the regression analysis, it is difficult to say whether the results of our study are consistent with or different from previous studies since there are both similarities and differences in their outlines. Our study focused on Swedish local conditions, analyzing representation of municipal politicians in transport-related committees and measuring transport sustainability through indexes illustrating both the presence of policy and planning documents and their implementations and actions, and it can be argued that this is somewhat in line with the study by Magnúsdóttir and Kronsell [93].

One explanation for representation not showing any correlation with sustainability outcomes in both studies might be that the Swedish transport sector is still run according to masculinity norms, which means that practices, planning and structures overrule the presence of women and any femininities they might bring with them—an aspect discussed by Pini and McDonald [110]. This is also in line with the results of Farrell and Titcombe [111], who reported the experiences of elected local officials in Wales and described the culture and ways of running offices as less appealing to women. The effect of female representatives might also be overruled by an attitude/intention-behavioral gap, as discussed among others by Pronello and Gaborieau [112]. Yet another explanation for representation not showing any correlation with sustainability outcomes could be that, since gender equality is a target in Swedish national policy, representation might not be as important for sustainability outcomes. Representation might be less important for including gender aspects when explicitly stipulated in the policy. The variation in our sustainability indexes is also limited compared to, for example, the study by Ergas and York [92], which made a global comparison of CO<sub>2</sub> emissions by country, making it more statistically difficult to capture an effect of female representation on sustainability outcomes.

As mentioned in Section 2.2, there is a higher degree of negotiation and co-operation across party boundaries at the local level than on the national level in Sweden. We therefore think it is less likely that we would have found a different result if we had also considered party affiliation in our analysis. However, and more importantly, we think that future studies should consider information on the hierarchal positions of female representatives, such as chairpersons, to examine differences in power. This was difficult to include in the current study analyzing representation in committees related to transport discussions, since there were often a number of such committees in each municipality, committees were sometimes shared between two or three municipalities, and the chairperson can change and is less stable during elected periods.

In conclusion, then, further research should be undertaken to better understand the relationship between representation and sustainable decisions in transport planning. The study presented in this article has not been able to show any significant correlations, but, as expected, the relationships between representation and sustainability are likely more complex than this study has been able to measure. Wilson and Chu [95] also, in a very well-articulated way, pinpointed the inadequacy of focusing merely on participation. This argument is also in line with Wängnerud [72], who suggested that the link is more probabilistic than deterministic, and the linkages are not straightforward but complex and multifaceted.



Even though the link between representation and sustainability demands further research, further studies should also consider how to move research from the counting of bodies and the representation of women in sustainable transport policymaking to looking at how gender norms inform policymaking, since the low representation of women in transport-related policymaking demonstrated here appears to be a more general trend. The study presented in this paper indicates that there is a need for further analysis of institutional factors and values embodied in organizations that somehow make transport a masculine-coded sector or, taking Nagel's [80] viewpoint, that the overrepresentation of men in transport policymaking has had substantive effects in terms of a predominantly masculine sector.

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