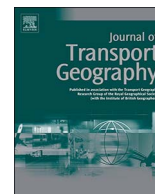




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## Gender equality and women's participation in transport cycling

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## ABSTRACT

Population-level health benefits are associated with cycling as a means for day-to-day travel. Several factors inhibit women's participation in transport cycling. The aim of the present study was to investigate the relationship between gender equality using the composite indicator of Gender Equality Index and its six core domains (work, money, knowledge, time, power, and health) plus violence and women's participation in transport cycling across the 28 member states of the European Union. The gross domestic product was included as a controlling variable. Results showed that the composite indicator of Gender Equality Index was associated with women's participation in transport cycling as well as with gender differences in participation in transport cycling. The core domains of health and work were not related to women's participation in transport cycling. Women's participation in transport cycling was associated with the following domains: time, power, and violence. The effect of gender equality varied across different indicators, with the strongest effect size found for time. The traditional sexual division of labour (gender gaps in caring and educating children or grandchildren, as well as in cooking and housework) may inhibit women's participation in transport cycling.

## 1. Introduction

Cycling as a means for day-to-day travel offers population-level health benefits (Götschi et al., 2016; Kelly et al., 2014). For example, commuter cycling is associated with a reduction in all-cause mortality and improvements in cardiovascular fitness (Oja et al., 2011). I note that there are detrimental effects of cycling such as exposure to air pollution (Zuurbier et al., 2010) and involvement in traffic safety incidents, especially collisions with motorized vehicles (Prati et al., 2017a). However, the health benefits of cycling are substantially larger than the potential mortality effect of greater exposure to air pollution and the increase in traffic accidents (de Hartog et al., 2010). Moreover, shifting to active modes of transport can achieve environmental and economic benefits, including reduced traffic congestion, air and noise pollution, and fossil fuel consumption (de Nazelle et al., 2011; Macmillan et al., 2014; Xia et al., 2013).

Although policy interest in promoting bicycle use as a mode of transport has increased substantially, the promotion of cycling does not seem associated with greater diversity (i.e., inclusion of different types of people) among cyclists. For instance, higher levels of bicycle use in United Kingdom were not related to an increase in the representation of women (Aldred et al., 2016) and inequalities in the London bicycle sharing system persist (Goodman and Cheshire, 2014).

Women's travel patterns are often more complex than those of men because of differing household and work roles buttressed by societal norms (Garrard et al., 2012; McGuckin and Nakamoto, 2004; Nobis and

Lenz, 2004; Rosenbloom, 1989, 2004). Although there is evidence of health benefits of cycling for women (Garrard et al., 2012), gender differences in mobility patterns include also women's lower use of bicycle. In an Eurobarometer by the European Commission on attitudes of Europeans towards mobility, the percentages of women who reported never using the bicycle as transportation mode were higher than that of men for all countries (European Commission, 2013). In Australia, Canada, and the United States, men make up a large share of cyclists (Garrard et al., 2012; Pucher et al., 2011). Different explanations have been advanced to account for under-representation of women in transport cycling. First, women tend to perceive more barriers or constraints to transport cycling and report lower levels of willingness to cycle (Akar et al., 2013; Dickinson et al., 2003; Heesch et al., 2012). However, it seems likely that socio-cultural and infrastructural factors influence these perceptions because the women's participation in transport cycling is relatively high in countries with a well-developed cycling culture (Pucher and Buehler, 2008). The wider body of evidence is of a strong relationship between overall levels of bicycle use and women's cycling (Garrard et al., 2012). Indeed, women's participation in transport cycling in high-cycling countries may be due to their relatively high-quality cycling infrastructure. According to Aldred et al. (2016) and Krizek et al. (2005), there are attitudinal differences towards infrastructure and cycling environments (e.g., a preference for segregation from motor traffic) between men and women. Furthermore, safety seems more of a concern for female cyclists than male cyclists and is a significant factor in bicycling choice (Akar et al., 2013;

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Dickinson et al., 2003; Garrard et al., 2012; Heesch et al., 2012; Krizek et al., 2005).

In addition to these explanations, Aldred et al. (2016) pointed out that culturally specific factors and gender roles are responsible for female take-up of cycling. For example, female students are less likely to have permission to bike to and from school without an adult than male students of the same age (McDonald, 2012). In her analysis of gender equality into transport policy in Sweden, Polk (2008) posits that the priorities of transport politics have been focussed on more traditional goals and gender equality was not considered an important aim.

Trip characteristics and division of time and distribution of tasks between women and men can be considered others important factors influencing women's participation in transport cycling. Specifically, in comparison with men, women are more likely to make escort trips or travel with heavy objects (Aldred et al., 2016; Dickinson et al., 2003). These trip characteristics are all less suited for bicycle travel. A difference in this domain reveals the persistence of sexual division of labour (e.g., housework and child care as women's responsibility). Indeed, the presence of children as well as household responsibilities plays a significant role in incrementing the probability of car use for women (Emond et al., 2009; Vance et al., 2004). In addition, the birth of a child is associated with a larger decrease in bicycle use among mothers than fathers (Scheiner, 2014). This greater use of car for child care and pickup services arises from patriarchal constraints that dictate traditional gender roles. In sum, wide gender inequalities in the division of time between women and men in relation to the different roles assigned to them by society (e.g., time spent on caring and educating family members, as well as time spent on cooking and housework) may prevent women from bicycle use. Therefore, it is possible to hypothesize that gender equality may be associated with women's participation in transport cycling. Specifically, the aim of the study was to test the hypothesis that levels of gender equality are negatively associated with the percentage of women who report never using the bicycle as a mode of transport across European Union (EU) countries.

Throughout all European countries, an unequal division of time and distribution of tasks between women and men persists, with women spending more time in housework and care activities (European Institute for Gender Equality, 2015). To measure gender gaps within a range of areas across European Member States, the European Institute for Gender Equality put forward the Gender Equality Index (European Institute for Gender Equality, 2015). The Gender Equality Index involves a composite measure that relies on information disaggregated by sex (sex-disaggregated data) to allow for a gender analysis of the situation across of European Member States. The aim of the Gender Equality Index is to measure gaps between women and men, where the equality in outcomes is the form of equality that is considered. Since gender equality is a complex and multi-dimensional concept, different domains of gender equality are considered. Specifically, eight domains of gender equality are considered: work (i.e., participation, segregation, and quality of work), money (i.e., financial resources and economic situation), knowledge (i.e., educational attainment, segregation, and lifelong learning), time (i.e., economic, care activities, and social activities), power (i.e., political, social, and economic aspects of power), health (status, behavior, and access), violence (i.e., direct and indirect forms of violence) and intersecting inequalities (i.e., discrimination and other social grounds). The combination of these six core domains (i.e., work, money, knowledge, time, power, and health) forms the Gender Equality Index and, as such, synthesises the complexity of the concept of gender equality. The composite indicator of Gender Equality Index provides an overall measure of the complex concept of gender equality, while the six core domains (work, money, knowledge, time, power,

health) focus on specific aspects of gender equality. The remaining two satellite domains (violence and intersecting inequalities) are conceptually related to gender equality, but are not included in the core index because they measure “an illustrative phenomenon — that is, a phenomenon that only applies to a selected group of the population issues focussing on protecting the integrity and dignity of individuals” (European Institute for Gender Equality, 2015, p. 11). The two satellite domains consider issues that are related to women only or examine gender gaps among specific segments of the population such as people with a disability or lone parents.

The aim of the present study was to investigate whether women's participation in transport cycling is related to gender equality in general as well as to specific domains of gender equality. I hypothesised that a higher gender equality would be associated with higher women's participation in transport cycling.

Gender equality is a complex and multidimensional concept comprising a range of factors encompassing social, cultural, historical, and economic processes. This study helps to clarify the influence of gender equality on women's participation in transport cycling by disaggregating its dimensions. Therefore, to address the complexity of gender equality and to provide a more fine-grained analysis of the influence of gender equality, the six core domains (work, money, knowledge, time, power, and health) were examined separately. Indeed, each of the six core domains has the potential to influence the choice of mobility mode and ways of moving, including bicycle use (Camargo et al., 2015; Garrard et al., 2012; Handy et al., 2014). In addition, since fear of crime and violence is supposed to influence women's travel behavior, including cycling (Emond et al., 2009; Loukaitou-Sideris, 2010), the satellite domain of violence was added to the analysis. Thus, the focus of the study was on the composite score of gender equality (i.e., Gender Equality Index) as well as on the core domains separately (work, money, knowledge, time, power, and health) plus the satellite domain of violence. Furthermore, since EU countries differ widely in their level of economic activity, the gross domestic product was included as a controlling variable.

## 2. Material and methods

### 2.1. Data

This study used data from three datasets. To measure the extent to which bicycle was used as mode of transport among women, data from the Eurobarometer survey on the attitudes towards mobility in the EU (European Commission, 2013) were used. Specifically, the data provide the percentages of women who never cycle as mode of transport across the 28 member states. TNS Opinion & Social network carried out the survey in the 28 member states of the European Union in 2013. Scores on Gender Equality Index across the 28 member states were provided by the European Institute for Gender Equality (2015). The Gender Equality Index was based on indicators available from different sources including Eurostat, the European Foundation for the Improvement of Living and Working Conditions (Eurofound) and DG Justice and Consumers (DG Justice). The Gender Equality Index considers the position of women and men to each other, producing a score bound between 0 and 1, where 1 stands for complete gender equality, while values below indicate a proportional lack of gender equality in a given indicator, with full gender inequality at 0. Information about the measurement framework, indicator selection, data, metric, and calculation of the Gender Equality Index is provided by the European Institute for Gender Equality (2015). The present study used the scores for the year 2012.

The gross domestic product of 2012 provided by Eurostat was

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