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Overview of Walking Rates, Walking Safety, and Government Policies to Encourage More and Safer Walking in Europe and North America

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Abstract: Walking is the most sustainable means of daily travel for short trip distances and is a key component of the overall transport system. This paper documents variation in walking rates among countries, cities in the same country, and in different parts of the same city. Our international analysis of official government statistics shows that walking rates are highest for short trips, higher for women than for men, decline with increasing income, and remain constant as age increases. Walking fatality rates are much higher in the USA compared with the other countries we examined, both per capita and per km walked. Government policies that would increase walking rates while improving pedestrian safety include: integrated networks of safe and convenient walking infrastructure; roadways and intersections designed for the needs of pedestrians; land-use regulations that encourage mixed uses and short trip distances; lower city-wide speed limits and traffic calming in residential neighborhoods; reduced supply and increased price of parking; traffic laws that give priority to pedestrians; improved traffic education for motorists and non-motorists; tax surcharges on large personal vehicles; and strict enforcement of laws against drink and distracted driving. Five decades of success with these policies in many European cities provide practical examples for car-oriented cities to follow, especially in North America.

Keywords: walking; pedestrian; safety; international comparison; time trends; modal share distribution; trip distance; demographics; government policies

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1. Introduction

Walking is the most sustainable means of daily travel for short trip distances [1–5]. It causes virtually no noise or air pollution and consumes far fewer nonrenewable resources than any motorized mode of transport. The energy that walking requires is provided directly by the traveler, and the use of that energy offers valuable cardiovascular exercise. Indeed, walking provides not only physical but also mental and social health benefits for people of most ages and abilities [6,7].

Walking requires only a fraction of the space needed for driving and parking cars. Moreover, walking is economical, costing far less than the private car and public transport, both in terms of direct outlays by users and of investments in public infrastructure [2,5]. Walking is affordable for virtually everyone and therefore is the most socially equitable of all transport modes [8]. It is also the oldest and most natural form of human travel [1,3].

Through their visible presence on and along streets—as human beings and not just vehicles—pedestrians contribute to the attractiveness, vitality, and social interaction of urban areas [4,9]. Thus, most urban designers, planners, and geographers in recent years have supported compact, mixed-used development that facilitates walking and reduces car-dependence, while opposing car-oriented, low-density, sprawl typical of North

American suburbs, in particular. They argue that cities should be designed for people and not for cars [1,3,5].

Walking is a feasible way to make some trips in their entirety—from origins to final destinations—provided the trip is short enough, which is often the case in parts of towns and cities where development is compact and mixed-use. Walking also provides crucial access to other modes. For example, the vast majority of public transport passengers reach their bus and rail stops by foot (80–83% in the USA), and even transfers between different public transport lines (for example, within a metro system) would be almost impossible without walking [6,7]. Walking is also essential for accessing cars—whether they are parked in driveways, on the street, in surface parking lots, or in parking garages. In short, the transport system could hardly function at all without walking [2,4].

In spite of its importance, walking was mostly ignored as a mode of transport by scientific literature prior to 1980, and not even included in some travel surveys. However, as a research topic, walking has experienced a boom in the past three decades. A search by the authors in the Web of Science [10] revealed an 80-fold increase in the average annual number of published peer-reviewed articles on the topic of walking from 1990 to 2021. Extensive scientific evidence now confirms the key role of walking in sustainable transport systems, livable cities, and healthy people.

Purpose and Structure of This Article

This article provides an overview of walking in Europe and North America, with a focus on Germany, Denmark, the Netherlands, the UK, and the USA. Our selection of countries and cities was based mainly on data availability and the comparability of their economic, political, and transport systems. The first section of the paper provides a broad overview of walking levels in 15 countries. Most of the countries are in Europe and North America, but in some instances we also include Australia, New Zealand and Japan to provide more international context.

The next stage of the paper narrows the analysis to the 10 countries with national travel surveys that cover all trip purposes and not just travel to work, as typical of country censuses. The 10 countries include 8 Western European countries, Japan, and the USA. For those countries, we examine variations in levels of walking by gender, age, and trip distance. The next section of the paper examines variations in walking safety across countries and over time. For that safety analysis, we examined per-capita fatality rates for 11 countries and per km fatality rates for 5 countries. In all cases, we included the USA, the UK, Germany, the Netherlands, and Denmark–the core countries of our analysis.

Last, we explore the many factors that influence walking levels and safety in the USA, the UK, Germany, the Netherlands, and Denmark, many of which are government transport, land-use, taxation, and regulatory policies. As we document, walking levels and safety are much lower in the USA than in the four European countries. For each of the nine categories of government policies we examine, the USA lags far behind the four European countries in establishing conditions for walking that are safe as well as convenient and pleasant. Thus, the final section of the paper consists mainly of lessons from Europe about how the USA and other car-oriented countries could increase walking levels and improve safety.

2. Data and Methods

Most of the data examined in this paper come from primary sources such as travel surveys [11–21], censuses [22–25], and traffic safety databases [26] provided by international, national, and city government agencies [27–33]. For each of the graphs we include as figures throughout the paper, we list the data sources and explain the methods used to analyze the data. Instead of providing a detailed examination of data and methods in this section, we discuss the data and methods in detail in each specific part of the paper where it is relevant, as both data and methods vary from one section of the paper to another. We note here, however, some data and methodological issues that come up through much of the paper.

Household travel surveys for countries and cities generally report data for trips from one address to another, omitting walk trips within the same address, such as in a shopping mall, office building, metro system, or walking down the driveway to retrieve the mail [34]. In addition, most surveys only report the mode of transport used for the longest part of the trip between two addresses—excluding short walk trips to and from public transport stops or parked cars. Thus, even the best available household travel surveys generally underestimate the total amount of walking because short access and egress walk trips are not included.

As we emphasize in the explanatory notes to each figure using data from national travel surveys, their comparability across countries is limited due to their somewhat different timing, although we used the most recent survey for each country, with survey years noted for each figure. Moreover, the sample sizes, variable definitions, data collection methods, and data weighting and refinement procedures vary among countries [6,34]. Whatever their limitations, the national travel surveys we use to produce the figures in this paper are the official government surveys for each country, and indeed are the only surveys available that report travel for all trip purposes.

Countries without national travel surveys rely on journey-to-work data from their censuses, reporting only the main mode (longest trip distance), thus explicitly excluding access and egress trips by walking. Censuses also focus on the usual mode used, excluding modes used only occasionally for the journey-to-work. Thus, censuses would report public transport as the usual and main mode of travel to work even for a person who walked the entire distance from home to work two days a week and walked to and from public transport stops to reach work the other three days a week. In that hypothetical example, walking clearly plays an important role in the journey-to-work but is not recorded at all due to the Census methodology and definitions. Most importantly, censuses exclude the other purposes of travel besides the commute to work, and as noted below, the walk modal share of trips is almost always higher for recreation, exercise, stress-relief, and socializing than for the journey to work. In short, both multi-purpose travel surveys as well as censuses understate the total amount of walking.

There is yet another overriding issue in measuring levels of walking and the share of walk trips. Most surveys, censuses, and academic studies focus on modal share as a percentage of trips, partly because respondents are more likely to remember (even if only approximately) the number of trips. There are two main alternatives: modal share as a percentage of total km traveled and modal share as a percentage of time traveled. The problem is that respondents' memories of trip distances and trip times are less likely to be accurate than whether the trip was made at all, and by what mode. For some purposes, however, travel km are key to standardizing exposure to traffic dangers—for example, in calculating fatality rates per km traveled. Controlling for other factors affecting safety, making a 10 km walk trip obviously exposes the pedestrian to more potential dangers than making a 1 km trip by foot. However useful the reported trip distances are, they are probably less reliable than the trip data. Even the trip data are limited in their usefulness because a 10 km trip by foot obviously entails more walking than a 1 km trip by foot. Thus, using trip data alone ignores the relative importance of trips of different lengths.

This paper reports official government data for each country or city. In general, the government agencies that conduct and analyze travel surveys use weights to adjust survey data to correspond to population socio-demographic characteristics. The surveys are also compared and adjusted to other transportation data, such as traffic counts, public transport ridership, automated pedestrian and cyclist counters, and other travel demand information. Aside from publicly available government data, we also rely on publications in the scientific literature that help substantiate the various points we make in the text, especially regarding explanations of the variations among countries and cities and trends over time in walking rates and safety.

3. Variation in Walking Levels among Countries and Cities

Although walking is an essential component in every transport system, its overall importance varies considerably: among countries, among cities in the same country, and among different parts of the same city.

3.1. Variation among Countries

Figure 1 shows differences among countries in the percentage of daily trips made by walking in 10 European countries, the USA, Canada, Australia, New Zealand, and Japan. Our selection of countries is based mainly on the availability of national travel surveys that include all trip purposes and not just work commutation. The exceptions are Ireland, Canada, and Australia, which only have journey-to-work data from their national censuses.

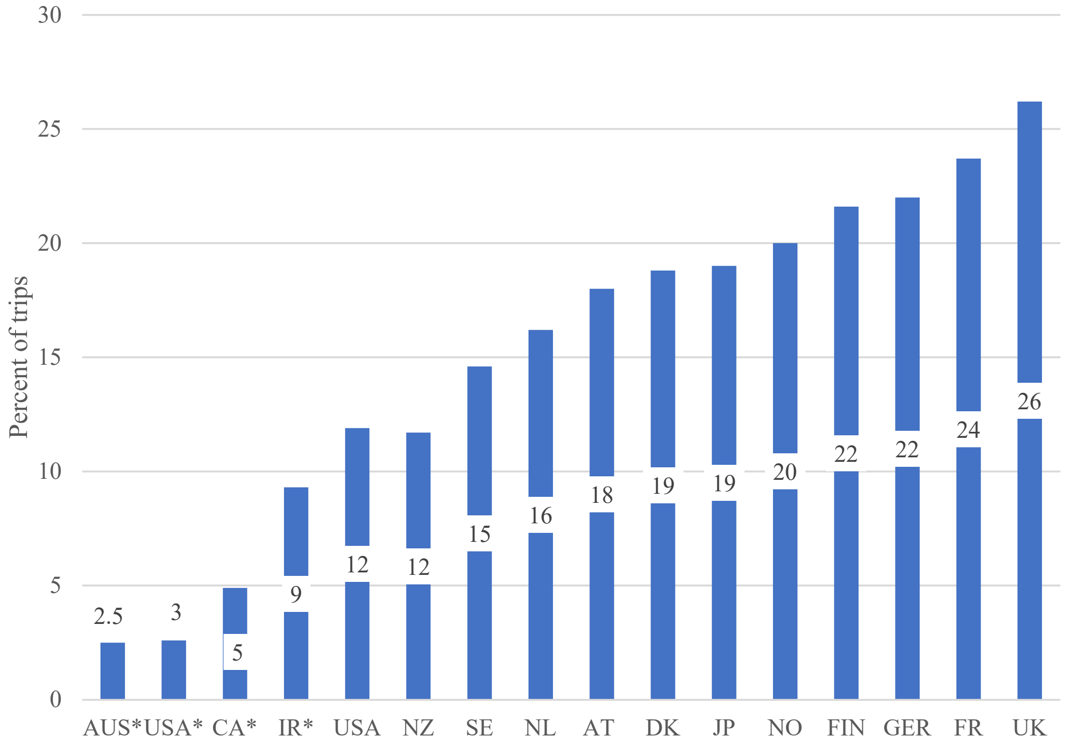

Figure 1. Share of trips by walking in Australia, New Zealand, Canada, the USA, Japan, and ten European countries, 2017–2019. Source: Latest available national travel survey of each country [11–24,27]. Note: Modal percentages for most countries are based on national surveys that report trips for all purposes. Countries designated with an asterisk (*) only report modal percentages for trips to work and thus are artificially low. Differences in data collection methods, timing, and variable definition across cities and over time limit comparability of the modal shares shown.

Walk mode shares of all trips (from national travel surveys) range from about 12% in the USA and New Zealand to 26% in the UK. The low rates of walking reported for Ireland, Canada, and Australia are almost certainly underestimated because they only reflect the journey-to-work as reported by their national censuses. As shown by travel surveys including all trip purposes, the walking mode share of work commutation trips is almost always lower than the walk shares of trips for other purposes, such as recreation and exercise. For example, the walk shares of all trip purposes combined is 12% in the USA, whereas the walk share of work trips is only 3%.

There are many possible factors that may help account for the variation in walk mode share. For example, the low walk mode shares (all trip purposes) in the USA (12%) and Sweden (15%) are probably due in part to their low population densities and high car ownership rates relative to the other countries. In the Netherlands—Europe's most densely populated country—the low walk mode share (16%) is likely due to the predominance of cycling for short trip distances [35]. In contrast, low levels of cycling in France and the UK might help explain the higher walking levels there [35]. Of course, there are many other factors that may explain the varying importance of walking, some of which we examine later in this paper.

3.2. Variation among Cities

Even within countries, there is considerable variation in the percentage of daily trips by walking. Figure 2 shows variation in walk mode shares for selected cities in the Netherlands, Denmark, Germany, Austria, Switzerland, Spain, Italy, France, the UK, and Japan. The data for cities in those countries are based on travel surveys including trips for all purposes. By comparison, Figure 3 shows walking mode shares only for the work trip because Ireland, Canada, and Australia do not have national travel surveys and rely on journey-to-work data from their censuses. Although the USA has a national travel survey, its sample size is too small to allow for disaggregation to the city level; thus, the city data for US cities are also restricted to work trips.

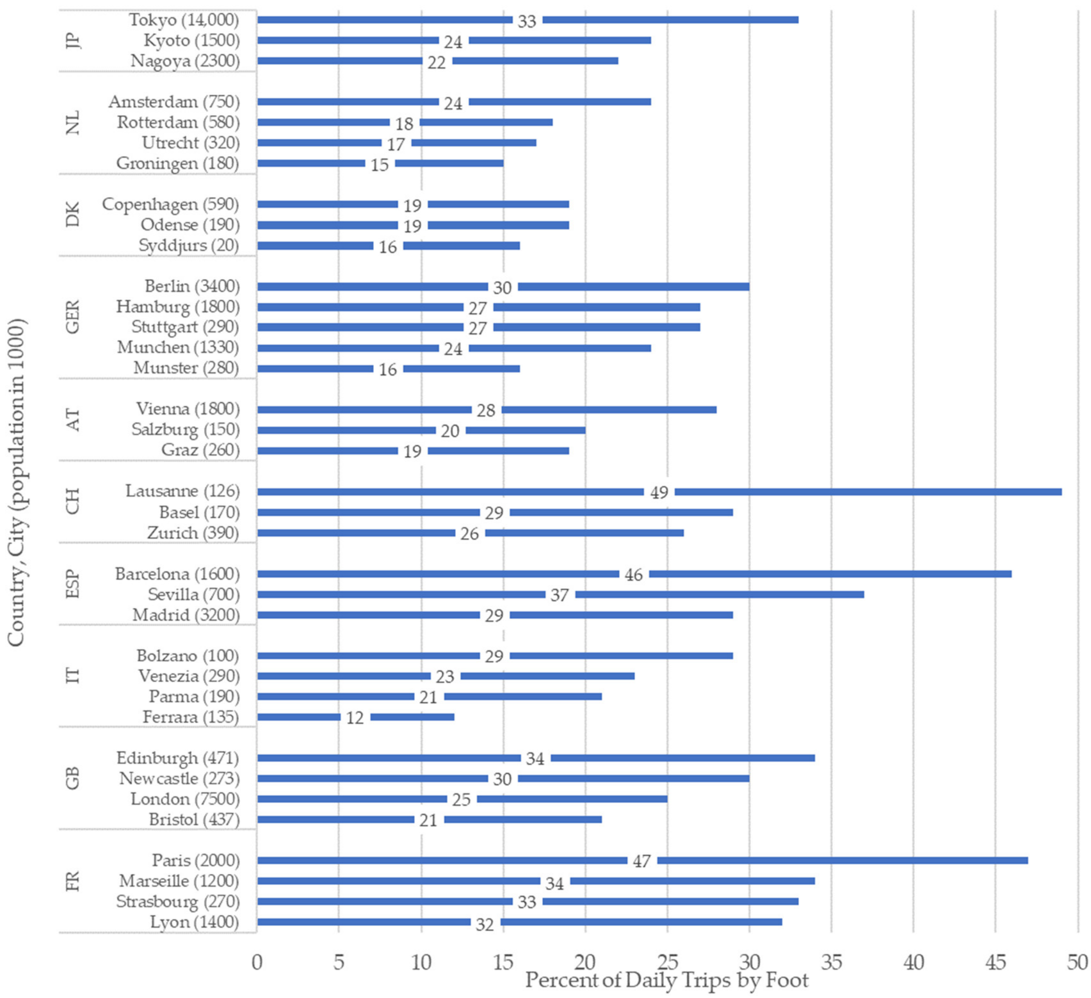

Figure 2. Walking share of trips in selected cities in Japan and 9 European Countries. Source: Latest available national travel survey of each city [11,27,28]. Note: Differences in data collection methods, timing, geographic boundaries, and variable definition across cities and over time limit comparability of the modal shares shown. In particular, modal percentages in this table include all trip purposes, whereas modal percentages in the following Figure 3 are only for trips to work and thus lower.

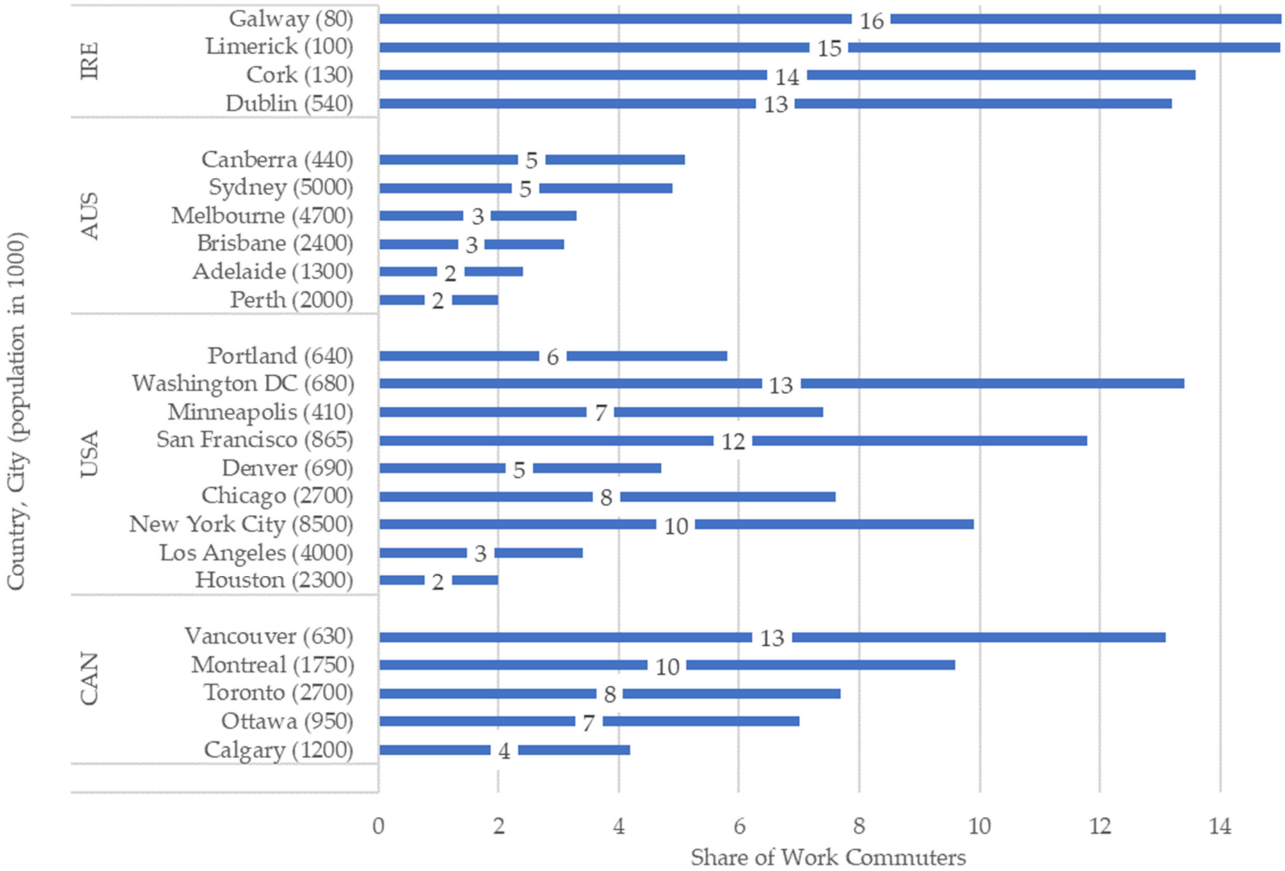

Figure 3. Walking share of work commuters in selected cities in Australia, Ireland, Canada, and the United States. Source: Latest available national census for each country [22–25]. Note: Differences in data collection methods, timing, geographic boundaries, and variable definition across cities and over time limit comparability of the modal shares shown. Due to extreme variation in the percentage of metropolitan area population located in the central cities, modal percentages for Australia are shown not for cities but for metropolitan areas. Walking modal shares in Australian central cities are much higher than in their corresponding metropolitan area.

There is variation in the modal share of walking among the cities shown for the 14 countries in Figures 2 and 3. Among European and Japanese cities (Figure 2), the highest walk mode share within each country grouping is at most twice as high as the lowest walk mode share. The situation is different for the four countries shown in Figure 3, but that might be partly because the mode shares only reflect work trips reported in their censuses and thus are not directly comparable with the travel survey data reported in Figure 2. The highest walk mode shares among cities in Ireland, Australia, Canada, and the USA are at most six times higher than the lowest walk mode shares. Even among the four countries shown in Figure 3, there are differences among countries in the degrees of variation, which is least among Irish cities and largest among cities in the USA.

Due to differences among countries and cities in their travel survey and Census methodology and timing, the walking modal shares shown in Figures 1–3 are not fully comparable. Our main point in presenting these three figures is to demonstrate the variation in walking shares of trips among countries and among cities in the same countries.

3.3. Variation within Cities and Metropolitan Areas

There is also considerable variation in walking levels within cities. In general, the denser, mixed-use, central portions of cities have shorter average trip distances and thus higher walking levels than outlying areas of the same cities. For similar reasons, cities have higher modal shares of walking trips than the suburban portions of their metropolitan areas. Due to space limitations, we provide only a few specific examples:

In New York City, the modal share of walk trips in 2019 was 54% in Manhattan, 48% in the Inner Bronx, Queens, and Brooklyn (closest to Manhattan), 33% in the Outer Bronx, Queens, and Brooklyn (further from Manhattan), and only 5% in Staten Island, which has the lowest population density and the highest levels of car ownership and use in New York City [32]. In Berlin, the city center had a walk modal share of 33% in 2012, falling to 27% in outer districts of the city and 18% in the suburbs [31]. In Munich, the walk mode share in 2012 was 36% in the city center, 31% in outer districts of the city, and 21% in the suburbs [29]. In Hamburg, the walk share of trips in 2012 was 33% in the city center, 24% in the outer districts of the city, and 17% in the suburbs [30]. In Vienna, the walk mode share in 2012 was 33% in the city center, 23% in outer districts of the city, and 19% in the suburbs [36]. Similarly, the walking mode share in Inner London was 37% in 2021 but fell to 24% in Outer London [37]. The walking mode share in the City of Paris was 52% in 2016, but it fell to 42% in the inner suburbs (Petite Couronne) and 29% in the outer suburbs (Grande Couronne) [33].

In short, walking mode share is highest in the innermost districts of cities and declines with distance from the center. Walk mode shares are lower in the suburbs than in the city itself, and among suburbs, walk mode shares are lower in the outer suburbs than in inner suburbs.

4. Variation in Walking Rates by Trip Distance

As suggested by the previous section, trip distance influences choice of travel mode. Short trip distances are essential to making walking a feasible means of transport. As shown in Figure 4, the modal share of walk trips peaks in the shortest distance category (shorter than 1 mi or 1 km) and declines over longer trip distances in all 10 of the countries included. The decline is especially sharp in the USA and UK, with less than 4% of trips by walking over the distance 2–5 mi. The declines are more gradual in the other countries. Indeed, the walk share of trips in most of the other countries ranges from 9–14% of trips up to 5 km long.

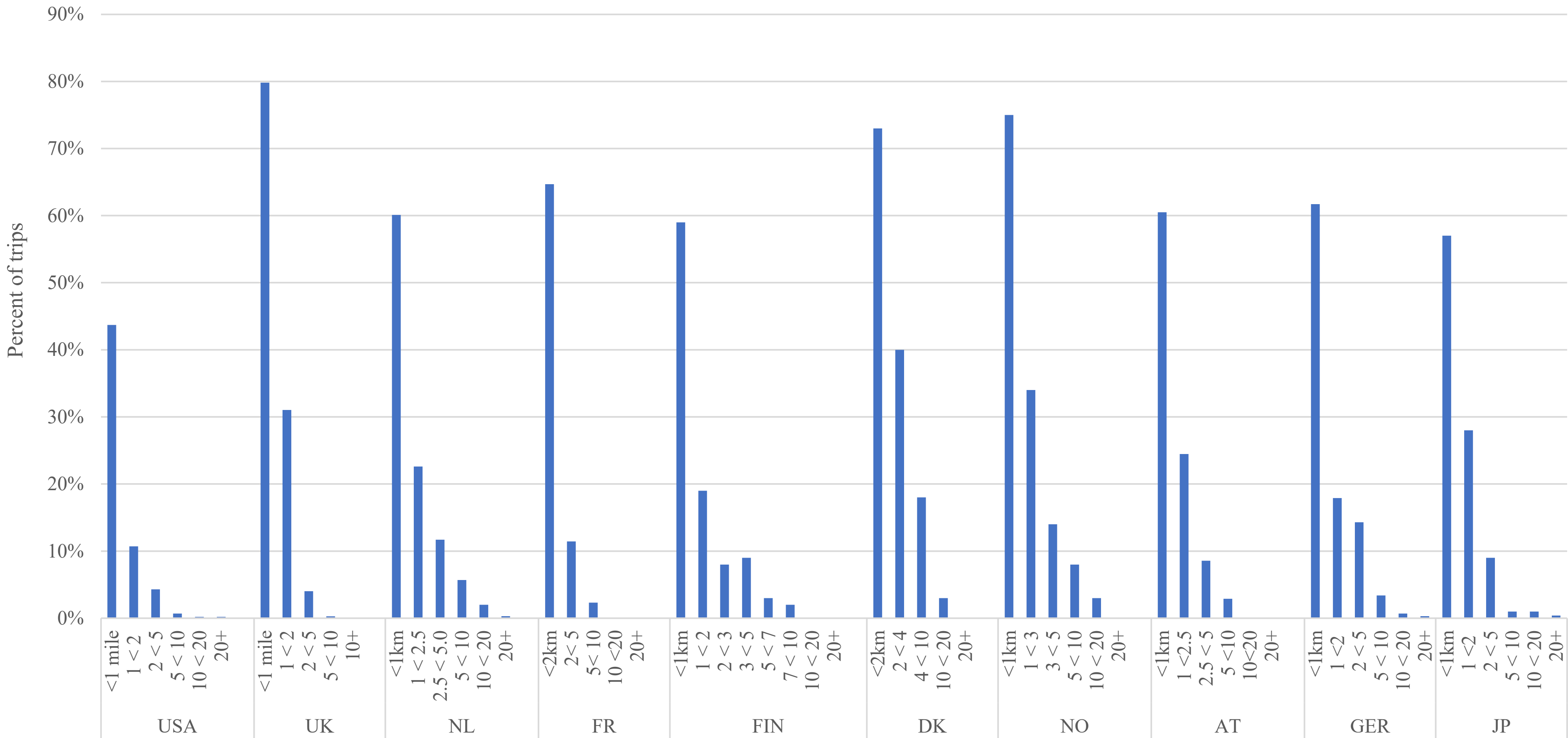

Figure 4. Variation by trip distance in walking mode shares of trips. Source: Latest national travel surveys for each country [11,12,14–20,27]. Note: Differences in data collection methods, timing, and variable definition across countries and over time limit comparability of the data.

Thus, even controlling for trip distance, walking mode shares within each of the trip distance categories are much lower in the USA than in the other 9 countries—indeed, half or less of the European levels. That suggests that the longer average trip distances in sprawled US metropolitan areas are not the only reason—perhaps not even the main reason—for the lower mode share of walking in the USA. Roughly 12% of all trips in US metropolitan areas are 0.5 mi or shorter, and 22% are a mile or shorter—distances that could easily be walked by most people, provided that safe and comfortable walking infrastructure is available [12].

Indeed, as shown in Figure 5, the distributions of trips (all modes, all trip purposes) by trip distance are not that different among the USA, Germany, France, the UK, and the Netherlands. For example, trips shorter than 2.5 km account for 30% of all trips in the USA, 36% in Germany, 37% in France, 39% in the UK, and 40% in the Netherlands. Similarly, trips shorter than 5 km account for 49% of trips in the USA, 54% in Germany, 55% in the UK and France, and 57% in the Netherlands.

The large differences in walk mode share within each trip distance category shown in Figure 4 contrast sharply with the relatively small differences in the distributions of trip distances for each country, as shown in Figure 5. Thus, it is clear that differences in trip distances are not the main explanatory factor for the large differences in walk modal shares among the countries, as shown in Figure 1.

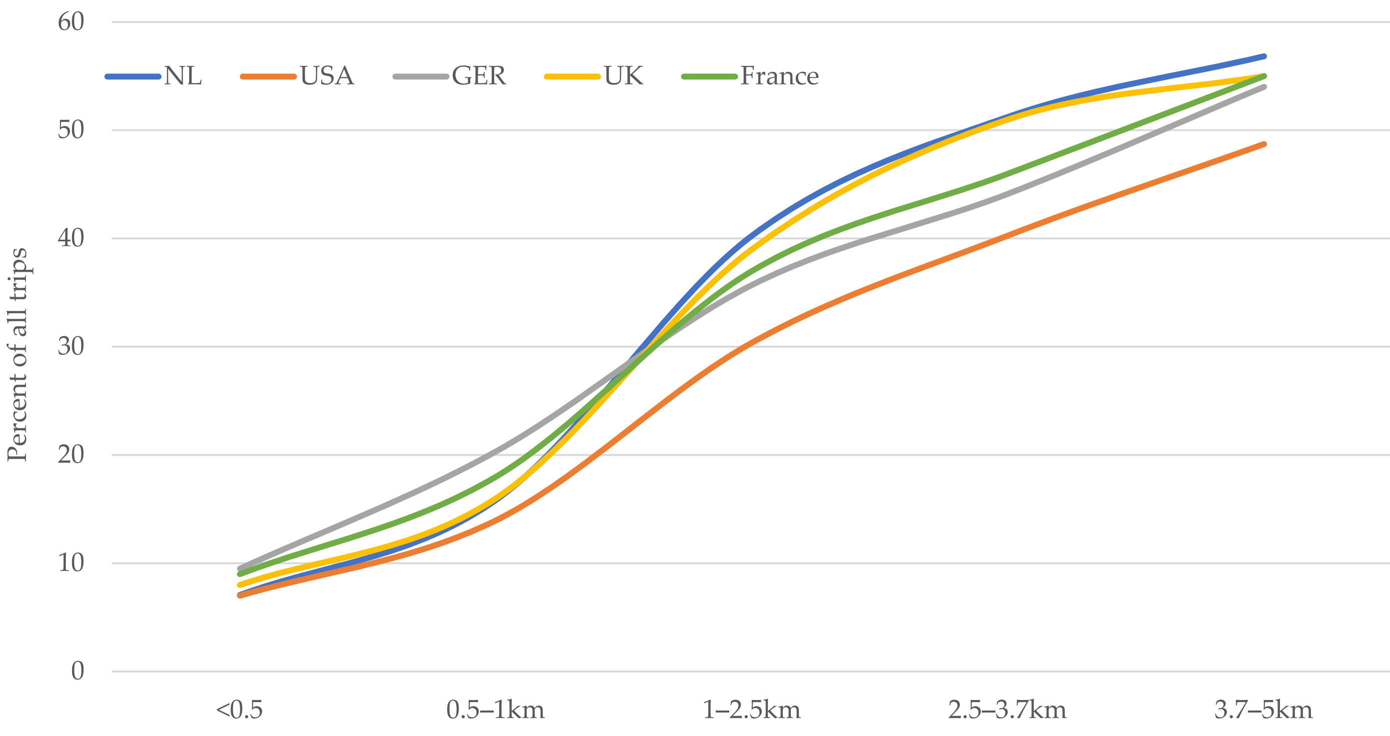

Figure 5. Cumulative distribution of trip lengths (all modes, all trip purposes) in the Netherlands, Germany, France, the UK, and the USA. Source: Latest national travel surveys for each country [11,12,15,19,20]. Note: Differences in data collection methods, timing, and variable definition across countries and over time limit comparability of distributions shown.

5. Variation in Walking Rates by Social and Demographic Factors

5.1. Variation by Gender

Women make a somewhat higher percentage of their trips by walking than men in all of the countries shown in Figure 6, ranging from 2% higher in the USA to 11% higher in Finland. The national travel surveys cited earlier [11-21] generally show that women have lower car ownership rates than men and make a lower percentage of their trips by car. The same surveys show that women have lower rates of cycling than men in many of the same countries. Their lesser reliance on driving and cycling might help explain the slightly higher walk share of trips by women.

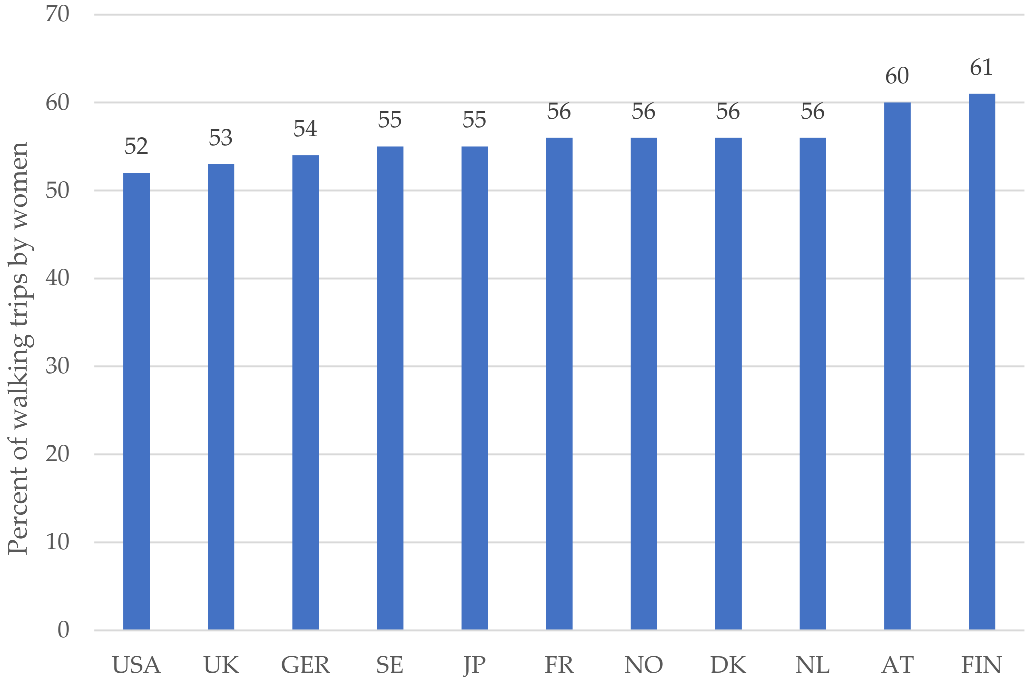

Figure 6. Variation among countries in women's share of total walking trips. Source: Latest national travel surveys for each country [11,12,14–20,27]. Note: Differences in data collection methods, timing, and variable definition across countries and over time limit comparability of the data.

5.2. Variation among Age Categories

In all the countries included in Figure 7, the highest shares of walk trips are in the youngest age categories. Among successively older age groups, however, there are large differences among countries. Walking rates remain roughly stable with increasing age in the USA, although at the relatively low rate of 12% of trips. Walking rates are much higher in the UK than in the USA, but they decline steadily with increased age, from 36% to 22%. The other seven countries included in Figure 7 exhibit a U-shaped pattern of walking rates with increased age, first declining among middle-aged groups and then increasing considerably for older adults.

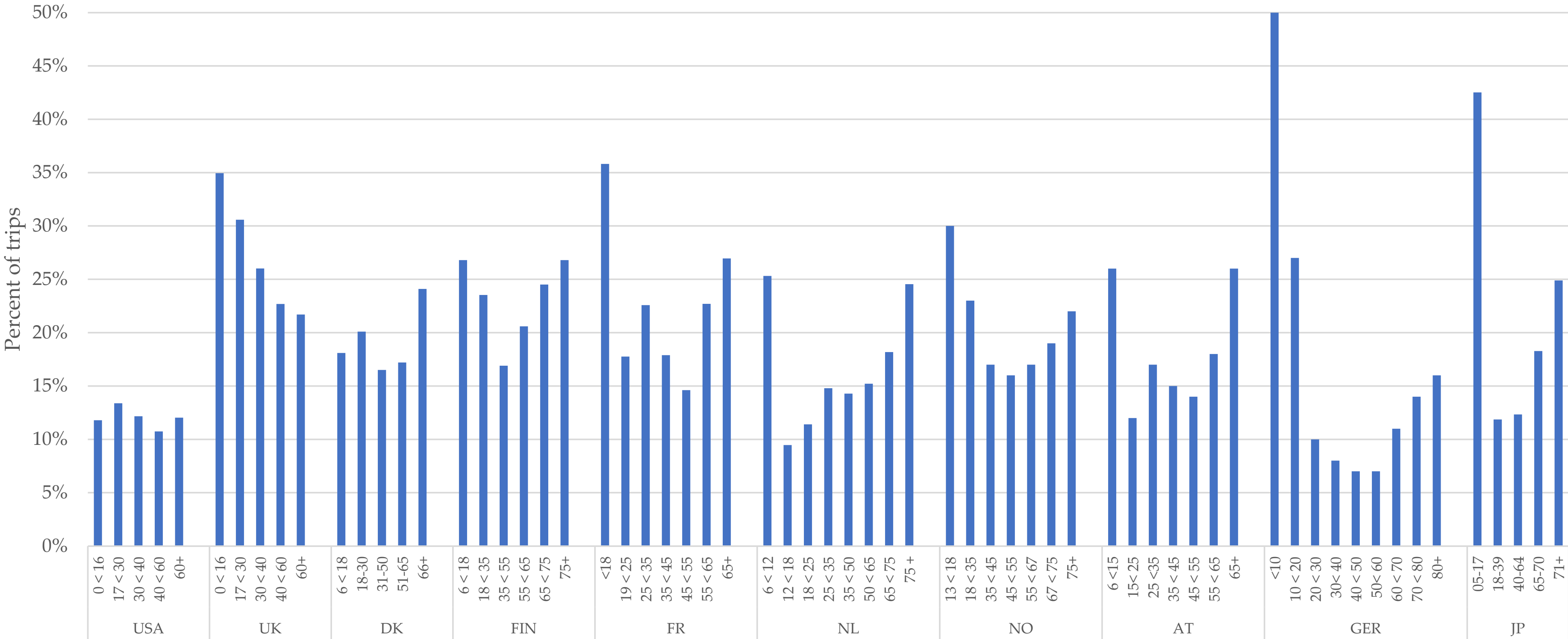

Figure 7. Variation across countries and age categories in share of trips by walking. Source: Latest travel surveys for each country [11,12,14–20,27]. Note: Differences in data collection methods, timing, and variable definition across countries and over time limit comparability of the data.

5.3. Variation by Income Level

As shown in Figure 8, rates of walking decline with increasing incomes in all three countries included: the Netherlands, Germany, and the USA. For each country, we divided travel survey respondents into income quintiles and ordered them from the 20% of surveyed respondents with the lowest incomes to the 20% with the highest incomes. The largest decline in walk mode share of trips was in the Netherlands, from 25% in the lowest-income quintile to 14% in the highest-income quintile. The decline was from 24% to 17% in Germany, and from 17% to 12% in the USA. Unlike the other two countries, there was a slight increase in walk mode share from the 4th to the 5th income quintile in the USA (from 10% to 12%). That might be due to the gentrification of central city areas in the USA since 2000, with most of the dense, mixed-use, expensive housing being occupied by high-income households, and with lower-income households priced out of the increasingly expensive central city neighborhoods.

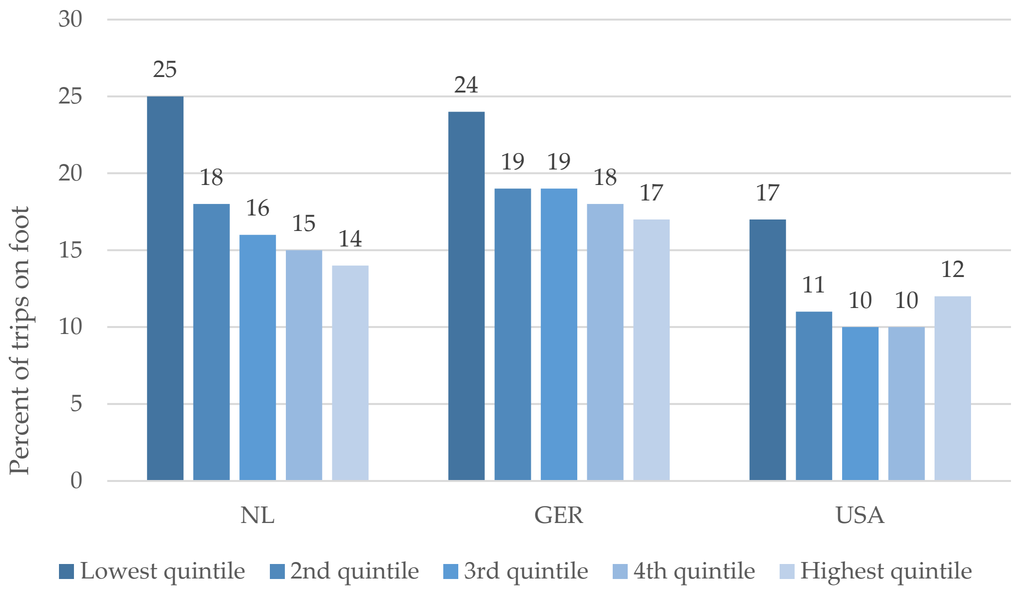

Figure 8. Variation in the share of trips on foot by income quintiles in the Netherlands, Germany, and the USA. Source: Latest travel surveys for each country [11,12,20]. Note: Differences in data collection methods, timing, and variable definition across countries and over time limit comparability of the data.

6. Variation among Countries and Trends in Walking Safety

This section examines variation among countries and trends over time in pedestrian fatality rates, first on the basis of fatality rates per 100,000 population, and then on the basis of fatality rates per 100 million kilometers walked. We did not include non-fatal injuries in our analysis because definitions of non-fatal injuries vary widely among countries and thus are not comparable [35,38,39]. As many studies have shown, however, traffic injuries far exceed traffic fatalities. According to the US Centers for Disease Control and Prevention, for example, there were 104,000 pedestrian injuries in 2020 that required hospital emergency room visits—16 times the number of pedestrian fatalities (6607) [40]. Thus, the reader should keep in mind the much greater magnitude of serious injuries compared to fatalities, as the risk of serious injury can also deter walking, especially among vulnerable or risk-averse persons (including the parents of children) [41].

6.1. Trends in Pedestrian Fatality Rates per 100,000 Population, 1990–2020

Figure 9 shows annual pedestrian fatalities per 100,000 population from 1990 to 2020, thus controlling for population changes in each country over the three decades. The rates are shown relative to the base year 1990 to control for differences among countries in 1990 in their initial walking levels and pedestrian fatality rates. Thus, Figure 9 focuses on improvements over time relative to 1990 and does not show absolute differences.

Fatality rates per capita fell in all eleven countries over the entire time period 1990–2020. However, the declines were much smaller in the USA than in the other countries: only 26% in the USA compared with declines of 60% in Canada, 62% in Japan, 73% in Germany and the Netherlands, 78% in the UK, and 79% in Denmark. The latest period of 2010–2020 brought a slowdown in pedestrian safety improvement in a few of the countries, but only in the USA did fatality rates increase–indeed by an alarming 25% in only ten years. By comparison, the per-capita rate remained roughly the same from 2010 to 2020 in the UK and continued to fall in the other four countries: Canada (−7%), Germany (−16%), Japan (−19%), Denmark (−19%), and the Netherlands (−19%). It is noteworthy that the decreases in fatality rates in Germany, Japan, Denmark, and the Netherlands are almost of the same magnitude—but in different directions—as the increase in the USA. Over the entire period of 1990–2020, there has been a large and growing gap in fatality rates per capita between the USA and the other six countries; however, that safety gap became much larger in the last decade, 2010–2020.

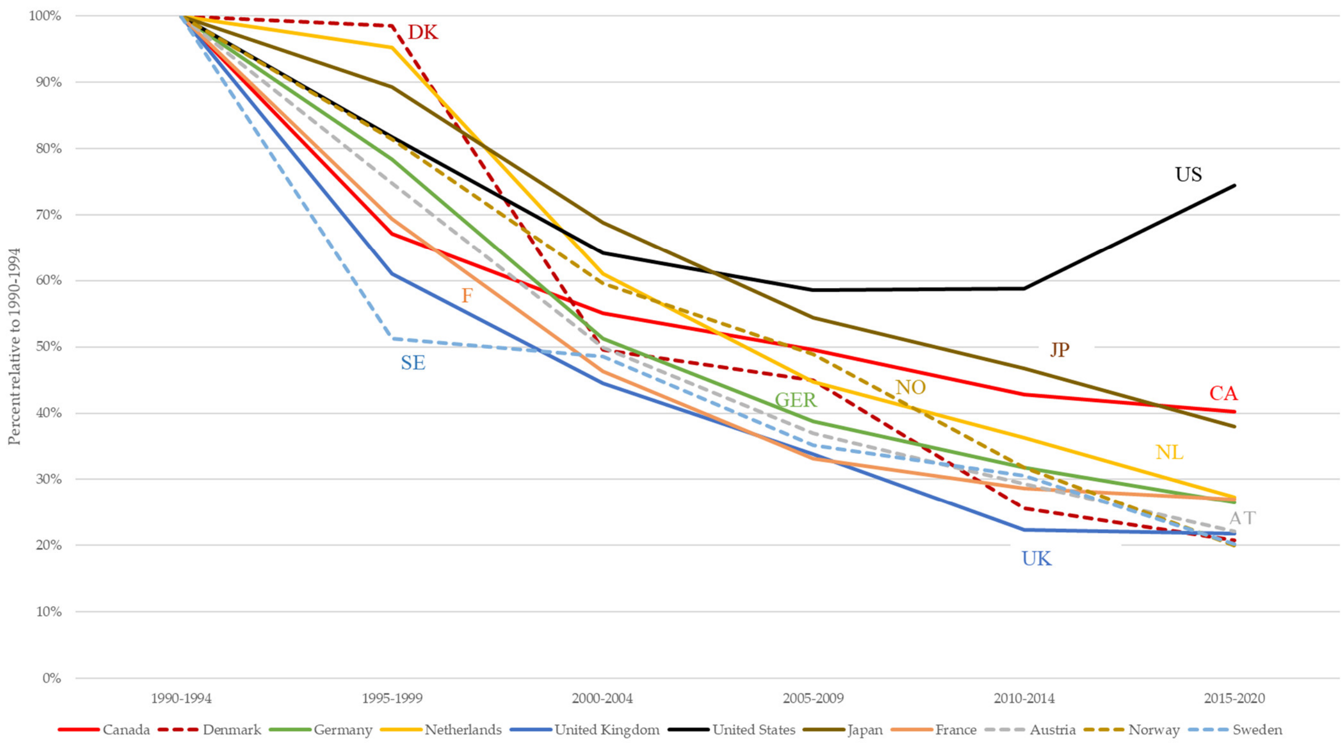

Figure 9. Trends in pedestrian fatalities per 100,000 population relative to 1990 in the USA compared with Canada, Japan, and 8 European Countries 1990–2020. Source: [26]. Note: To control for annual fluctuations in the number of pedestrian fatalities, we used five-year averages to generate this comparison of trends in pedestrian fatality rates. For each country the fatality rate for 1990-1994 was set at 100% as base year. All other years are presented as percentage relative to 1990-1994.

6.2. Fatality Rates per 100 Million Kilometers, 2000–2018

The per-capita rates shown in Figure 9 control for changes in population over time but not for changes in levels of walking, which is a crucial exposure rate for measuring pedestrian safety. Based on data from national travel surveys and traffic fatality statistics,

Figure 10 shows pedestrian fatality rates per 100 million km walked, thus directly controlling for changing exposure rates over time for the countries. Moreover, unlike Figures 9 and 10 shows absolute differences in fatality rates, not just percentage changes relative to a base year (1990 in Figure 9). Because comparable national travel surveys are not available for all countries, we were only able to examine per km fatality rates in five countries: the USA, UK, Germany, the Netherlands, and Denmark. Moreover, national travel surveys are only available for certain years. That restricted our comparison in Figure 10 to a shorter time period, 2000–2018, roughly two decades compared with three decades in Figure 9. Due to the slightly different timing of the national surveys, we grouped the survey and fatality data into two groups of years: 2000–2002 and 2016–2018.

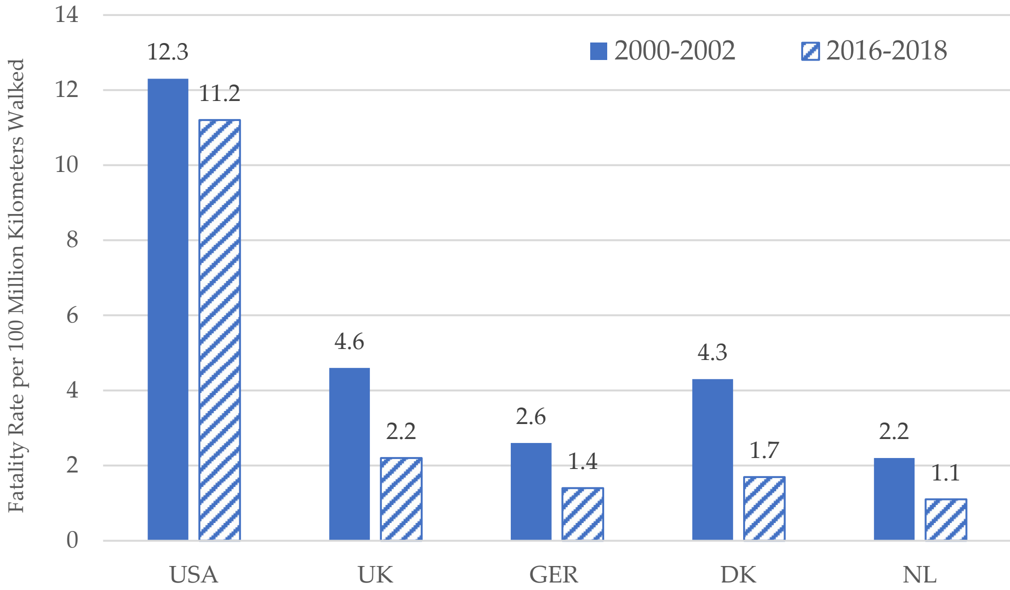

Figure 10. Trends in pedestrian fatalities per 100 million kilometers in the USA, the UK, the Netherlands, Denmark, and Germany, 2000–2018. Source: National travel surveys and national travel fatality statistics in each country [11,12,15,18,20,26]. Note: Differences in data collection methods, timing, and variable definition across countries and over time limit comparability of the data.

Figure 10 confirms the general pattern shown in Figure 9 for the five countries included in both figures. Even controlling for different levels of exposure (trip distance), pedestrian fatality rates per 100 million kilometers were much higher in the USA than in the other four countries, both in 2000–2002 and in 2016–2018, with the gap increasing over time. Per km fatality rates in 2016–2018 ranged from 7–10 times higher in the USA (11.2) than in the Netherlands (1.1), Germany (1.4), and Denmark (1.7), and 5 times higher than in the UK (2.2).

Consistent with the growing per-capita fatality rate gap shown in Figure 9, the per km fatality rates between the USA and the other four countries shown in Figure 10 have increased over time. For the overall period from 2000 to 2002 and from 2016 to 2018, pedestrian fatality rates per 100 million kilometers fell by only 4% in the USA compared with sharp reductions of about half in the Netherlands (56%), Denmark (54%), Germany (50%), and the UK (50%).

7. Government Policies Affecting Walking Levels and Safety

As documented in the preceding sections of this paper, there are large differences among countries in both walking levels and walking safety rates. This section examines a range of government policies that affect walking levels as well as walking safety. These policies include measures explicitly focused on walking (such as pedestrian infrastructure) but also include government measures such as motor vehicle speed limits, other traffic regulations, and law enforcement that have important impacts on walking levels and safety. As we document below, even land use and development policies are crucial, as they determine trip distances between origins and destinations, the mix and density of land use, and the safety of walking through roadway configuration and design.

We focus on a comparison of policies in the USA, the UK, Germany, Denmark, and the Netherlands, but we include some examples from other countries as well. Organized by type of government policy, this section explores three issues:

(1) What differences in government policies might help explain the variation among countries in levels of walking?
(2) What differences in government policies might help explain why walking is so much more dangerous in the USA than in Western Europe and Canada?
(3) Based on their successful implementation in some places, which government policies have proven to be effective at raising walking levels while also improving pedestrian safety?

7.1. Walking Infrastructure

Unsafe, incomplete, and inconvenient walking facilities are a major deterrent to walking [1–4,35]. In contrast, safe and connected networks of pedestrian facilities promote walking by separating and protecting pedestrians from motorized traffic. In pedestrian-friendly cities, these networks comprise sidewalks on both sides of the street; highly visible, clearly marked, often raised, and well-lit crosswalks; median islands in roadways that allow pedestrian to cross in two stages; leading pedestrian green phases at signalized intersections with sufficient crossing times for all pedestrians; as well as turn restrictions for motor vehicles at especially dangerous intersections [1–4,35].

Even though there is variation within cities and among cities in the same country, Western European cities generally provide better, more extensive, and safer networks of walking facilities than cities in the USA. Moreover, Western European cities started implementing pedestrian friendly infrastructure already in the 1970s, whereas most cities in the USA only started in the early 2000s [1,2,5,35,39,42,43]. That difference in timing may help explain the diverging rates in pedestrian safety from 1990 to 2010 documented in Section 6 of this paper, but not the sudden surge in pedestrian fatalities in the USA since 2010.

7.2. Roadway and Intersection Design

Roadway and intersection design directly affect pedestrian safety and convenience. Since at least as far back as the 1950s, most roadways and intersections in the United States were designed with the goal of maximizing vehicle flow and limiting delays for motorized traffic [44]. Thus, standard U.S. roadway design guidelines were car oriented for at least seven decades and often ignored the needs of pedestrians entirely, even in urban areas [44–47]. The car-oriented AASHTO guidelines used by almost all roadway planners, designers, and engineers have been challenged in recent years, and improved roadway designs have emerged that explicitly take into account the needs of pedestrians [47]. However, in most communities the decades-long practice of focusing on vehicle throughput has resulted in wide roadways, many and wide traffic lanes; intersections that permit turns at high speeds, high overall speed limits, and high traffic volumes, all factors that endanger pedestrians and make walking inconvenient [48,49].

In contrast, roadway design standards in European countries have considered walking and pedestrian safety for many decades [50]. Compared with the USA, that has resulted in narrower roadways; overall lower speed limits; slower turn speeds as well as turn restrictions; and lower traffic volumes. Thus, most roadways and intersections in Western European countries are specifically designed to ensure safe, convenient, and low-stress walking [1,2,5,35,39,42,43].

7.3. Urban and Suburban Development Design

In addition to car-friendly roadway design, zoning codes in most U.S. municipalities require a strict separation of land uses, thus increasing trip distances [4,49,51]. Based on these zoning regulations, suburban homes in the United States are typically built along roadways that end in cul-de-sacs intended to reduce through traffic in suburban neighborhoods. However, that design limits the connections of these homes to shops, schools, and workplaces to arterial roadways only accessible by automobile. Those arterials typically have high speed limits, lack sidewalks, and have no or few crossings for pedestrians [4,48,49]. Many suburban neighborhoods in the USA were built without any pedestrian sidewalks at all. Even those pedestrian walkways that do exist are often circuitous and designed for leisure walks but not to reach destinations outside the residential development [3,5,48,49].

In contrast, zoning regulations in European countries encourage mixed land uses, with shorter trip distances that can easily be covered on foot [51]. Even areas zoned for residential uses in Europe often allow doctor's offices, corner stores, daycare centers, or other land uses—putting many destinations for daily activities in close proximity to homes [51]. Moreover, most developments in Europe provide sidewalks, crosswalks, and other pedestrian amenities to facilitate trips on foot to nearby destinations [5,35,39].

Overall, land-use planning and zoning in the USA have resulted in longer trip distances and urban environments that are unwelcoming and dangerous for pedestrians. That also helps explain the lower share of walking trips in the USA compared with Europe. More recently, some communities in the USA are changing their zoning ordinances to allow more mixed-use development with shorter trip distances. European cities have a long history of designing compact cities with much greater accessibility for pedestrians due to shorter distances between residences and destinations of daily life, such as supermarkets, shops, daycare centers, doctor's offices, parks, or restaurants. That has also been the case for many small European towns and villages, and more recently, for suburban developments around some cities.

7.4. Reduced Speed Limits and Traffic-Calming

The severity of motor vehicle crashes increases with vehicle speed. At lower speeds crashes are less severe or can be avoided altogether because drivers have more time to react. International research and best practice emphasize the need to keep speeds slower than 30 km/h [3,52–55]. Between 2010 and 2015, most (56%) pedestrian fatalities in the United States were on roadways with speed limits greater than 35 mph (56 km/h) [39,56]. Many urban and suburban arterials in the U.S. have speed limits of 45–55 mph (75–88 km/h) which pose a great danger for pedestrians (and motorists) [49]. In contrast, speed limits in Western European cities are typically below 50 km/h. Speed limits are not only higher in the United States, but a study by the OECD found that almost 75% of U.S. drivers admitted to regularly exceeding the posted speed limit, compared with lower shares in Britain (22%) and the Netherlands (45%) [57].

Traffic calming of residential streets is much more common in European cities, further reducing car travel speeds compared with the USA. Traffic calming comprises a wide variety of physical measures to slow down automobiles and discourage traffic through neighborhoods. Vertical traffic calming measures require vehicles to drive over physical obstacles such as speed bumps, speed humps, raised crosswalks, and raised intersections [58]. Horizontal traffic calming measures force drivers to slow down through road narrowing, chicanes (curves), alternate-side street parking, traffic circles, or diverters, which deter through traffic. Special pavement treatments such as cobblestone also slow down drivers [9,35,39].

In 2017, 75% of all local streets in the Netherlands were traffic calmed with speed limits of 30 km/h or less [9,59]. Other countries do not provide national statistics on traffic calming, but data are available for some cities. In Germany, for example, large cities such as Berlin (78%), Cologne (75%), Hamburg (50%), and Munich (85%) have traffic-calmed the majority of their roadway networks to 30 km/h or less. Smaller cities such as Freiburg or Muenster have traffic-calmed almost all of their residential streets [60]. In addition to the usual 30 km/h traffic calming of residential neighborhoods, Dutch and German cities have designated some residential streets as home zones (Woonerven in the Netherlands; Spielstrassen in Germany) with speed limits of only 7 km/h [1,2,5,9,35,39]. In home zones, drivers must yield to pedestrians, cyclists, and children playing in the street, thus fully sharing the street with them [9].

Traffic calming of entire neighborhoods is rare in the USA. Some American cities, however, have traffic-calmed specific streets. In general, speed limits in traffic-calmed areas in the USA are higher than in Europe (often 25 mph or 40 km/h vs. 30 km/h). Moreover, traffic calming in U.S. cities is typically not area wide and often limited to fewer physical street modifications than in Europe. More recently, some American cities—such as New York, Philadelphia, Boston, Portland, and Washington, DC—have reduced their city-wide speed limit to 25 mph. In addition, some cities in the USA have implemented so-called "slow zones" with a speed limit of 20 mph (32 km/h) [39,61].

Many European cities have car-free areas in their city centers as well as outlying commercial centers [2]. Banning motorized traffic altogether—except for deliveries in the morning and evening—greatly increases traffic safety for pedestrians. In some car-free areas, cyclists are required to dismount—eliminating any potential crashes between cyclists and pedestrians [39,60]. Some cities in the USA also have car-free streets in downtowns or commercial centers. Similar to traffic calming, car-free zones are less typical and smaller in the USA than in Europe, where they often extend over entire networks of streets and plazas [2,9,60]. In contrast, car-free zones in the USA are not area-wide but instead limited to specific sections of isolated streets, such as Broadway between 34th Street and Times Square in New York, Downtown Crossing and Faneuil Hall Marketplace in Boston, or 16th Street Mall in Denver [62].

7.5. Car Parking Supply, Regulation, and Pricing

Convenient and free car parking encourages driving. Local regulations in most U.S. municipalities require a minimum supply of car parking for every new development. Those minimum standards are based on observed car parking demand in suburban areas with free car parking, and are thus artificially high [63]. As a result, car parking is oversupplied in the USA, and the vast majority of car trips end at destinations with free car parking. A large supply of free car parking encourages driving and is linked to more suburban sprawl and longer trip distances, which in turn make walking more difficult [63]. In addition, on-street parking takes up space that would be needed for (wider) sidewalks. Restricting car parking and increasing its cost can help reduce driving and increase walking and make it safer.

Many European cities have implemented parking management programs to reduce the number of car parking spaces in cities while increasing parking prices and limiting the maximum duration of on-street parking. In residential neighborhoods, parking permits limit long-time access to on-street parking to residents and sometimes prohibit non-residents from parking in a particular area altogether [5,9,60,64]. Some cities in the USA have also been implementing parking management programs and have revised local ordinances to limit car parking, but they remain the exception to a continuing history of oversupply and underpricing of car parking.

7.6. Traffic Laws and Enforcement

As noted above, speed limits are lower and more strictly observed in Dutch, Danish, German, and British cities than in American cities. That is partly due to stricter police enforcement in Europe [39,57,65,66]. Use of automated cameras to detect, document, and ticket motorists speeding or running red traffic lights is widespread in the Netherlands, Denmark, and Germany. Tickets are often issued automatically, including a photo of the driver and the car's license plate. That sort of camera surveillance and automatic ticketing is unusual in the USA, where it is prohibited by law in some states as an invasion of privacy [57,67]. There is also widespread public and political opposition in many cities to camera surveillance and automatic ticketing, both for running red lights and speeding. Only 12 states in the USA have any cities with automated speed cameras; only 22 states have any cities with red-light cameras [39]. The biggest exception is New York City, which implemented the largest speed camera program in the Americas from 2018 to 2022, with 2200 cameras operating in 750 school speed zones [68]. These cameras have reduced speeding by 72 percent at the locations where they are installed, demonstrating the dramatic benefits automatic camera surveillance and ticketing can have.

Traffic laws in the Netherlands, Denmark and Germany give special consideration to the vulnerability of pedestrians in any interactions with motor vehicles [39,69,70]. They require motorists to make special efforts to anticipate potentially dangerous situations and proactively avoid hitting pedestrians–requirements that are taught in motorist training and tested in driver licensing [71]. Moreover, motorists are generally assumed to be legally responsible for most collisions with pedestrians, especially children and older adults, unless it can be proven that the pedestrian deliberately caused the crash [70]. The legal priority of pedestrians puts motorists on the defensive, providing yet further incentive to avoid endangering pedestrians.

Traffic laws intended to protect pedestrians from motor vehicles are more strictly enforced by the police and courts in the Netherlands, Denmark and Germany than in the USA [39,42,57,65,66]. Several studies document the general failure of the police and courts in the USA to ticket, prosecute, and punish motorists who endanger pedestrians, even in cases of fatal crashes [49,71–73]. Moreover, there is much less enforcement of laws against drink driving and distracted driving in the USA than in Europe, leading to unsafe driving that increases the traffic dangers of walking.

7.7. Traffic Education

Many school districts in the Netherlands, Denmark, and Germany offer traffic education as part of their regular curriculum [71]. By the third or fourth grade, most children have had classroom instruction and practical training in safe walking and cycling skills, which is important because children in those countries walk or bike for a large share of their trips (NL: 64%, DK: 51%, GER: 43%, UK: 34%) [39,60,74]. By comparison, few American schools offer that sort of traffic safety training for young children, perhaps because such a small percentage of American children get to school by walking or cycling, indeed only 10% in 2017 [74]. In addition to safety training, such training courses in schools ensure that every boy and girl is accustomed to walking and cycling to school by the third or fourth grades of elementary school.

In sharp contrast, most American schools offer free or inexpensive driver training classes in high school, which prepare them for obtaining a driver's license as soon as they reach the minimum age in their state, varying from 16 to 18 years old [67]. The Netherlands, Denmark, Germany, and the UK require far stricter and much more expensive motorist training and licensing than in the USA [39,60]. As noted above, motorist training and testing in those four European countries include a specific focus on avoiding endangerment of pedestrians and cyclists, especially children and seniors [71].

7.8. Motor Vehicle Size

Several studies show that larger motor vehicles pose a much greater safety hazard for pedestrians than smaller vehicles [75–78]. The greater weight and higher, wider, blunter fronts of personal light trucks such as Sport Utility Vehicles (SUVs), pickup trucks, and minivans are more likely to cause severe injury and death in crashes with pedestrians [79–82]. Personal light trucks accounted for 72% of total new personal vehicle sales in the USA in 2018, compared with 27% in Denmark, 28% in the Netherlands, 36% in Germany, and 39% in the UK [83,84]. Moreover, personal light trucks in the USA are larger and more powerful than those in Europe. That is yet another factor that might help explain why pedestrian fatality rates are so much higher in the USA than in Europe and have been rising since 2010. From 2000 to 2018, the percentage of light trucks in new personal vehicle sales increased in all five countries, but the increase in the USA was from a much higher base: from 49% to 72% in the USA compared with an average increase from 7% to 33% in the four European countries [83–85]. The dramatic increase in personal vehicle size and power in the USA might help explain the sharp increase in pedestrian fatalities from 2010 to 2020.

Larger vehicle size in the USA is partly due to government tax and regulatory policies. For example, the greater popularity, larger size, and more powerful personal light trucks in the USA are obviously encouraged by the much lower price of petrol in the USA: USD 0.81 per liter in 2018 compared with USD 1.73 in Denmark, USD 1.82 in the UK, USD 1.95 in Germany, and USD 2.05 in the Netherlands [86]. Federal and state government petrol taxes account for a range of 61–67% of total petrol price in the four European countries compared with only 21% in the USA [86]. Thus, the higher price of petrol in Europe is mainly the result of higher taxes, which indirectly encourage smaller, less powerful, more energy-efficient personal vehicles in Europe than in the USA. Compounding the impact of petrol taxes, government taxes and fees on motor vehicle purchase and ownership are higher in Europe than in the USA, often directly related to the size, power, and emissions of a vehicle [87,88].

The much lower petrol taxes and prices in the USA also encourage more vehicle miles traveled. From 2010 to 2019, for example, total vehicle miles of personal travel in the USA rose by 10.2% [89]. In combination, the surge in motor vehicle miles plus the increased size of those vehicles might help explain the sharp rise in pedestrian fatality rates over the same period. It would also help explain the growing gap in pedestrian fatality rates between the USA and the four European countries.

7.9. Distracted Driving and Drink Driving

Many studies have concluded that drink driving is one of the most important causes of traffic fatalities [38,78,90–92]. Available statistics indicate that alcohol-related traffic fatalities are far more prevalent in the USA (29% of traffic fatalities) than in the Netherlands (5%), Germany (7%), the UK (11%), and Denmark (13%) [38,57,78,92].

Moreover, the percentage of fatal crashes involving alcohol has fallen during the past two decades in the other four countries, whereas it has remained roughly the same in the USA. The USA allows a higher maximum alcohol content in the blood than the Netherlands, Germany, and Denmark (0.8 vs. 0.5 mg/100 ml), making the much higher incidence of drink driving in the USA even more problematic [38]. One possible reason for the higher rate of drink driving in the USA is less frequent police checks, as indicated by two studies [57,67]. Distracted driving by motorists–especially mobile phone use–is another factor that may contribute to walking and cycling dangers. CDC [93] analyzed comparable surveys of self-reported incidence of distracted driving for the USA and European countries. The CDC found that in 2011, 68% of American adults reported using their mobile phones while driving compared with 21% in the UK, 39% in Germany, and 49% in the Netherlands; 30% of Americans reported texting while driving compared with 17% in the UK, 20% in Germany, and 24% in the Netherlands.

One possible reason for the difference might be that the European countries have more strictly enforced regulations prohibiting use of hand-held mobile phones for talking or texting while driving. Although such regulations also exist in many American cities and some states, they are rarely enforced. For example, only 21 states allow police to ticket hand-held mobile phone use while driving as a primary offense, whereas in other states it can only be ticketed as a secondary offense when motorists are stopped and ticketed for other traffic violations. Studies show that driver distraction has worsened in many countries in recent years due to increased ownership and use of smartphones as well as increasingly complicated car control consoles that take the motorist's eyes off the road [65,79,91,94–99].

The lack of police enforcement of laws against drink driving (and other forms of driving under the influence of drugs) and distracted driving is an important government policy that obviously encourages more drink driving and distracted driving in the USA than in the four European countries we choose as examples for comparison. Compounding the lack of police enforcement, courts in the USA generally impose much more lenient penalties for motorist violation of traffic regulations than courts in Europe [71–73]. In an analysis of over 1,000 pedestrian fatalities in New York City, Komanoff [72] found that only about 5% of drivers who—according to police reports—were unquestionably at fault in fatal crashes faced severe penalties from the courts [72]. The worsening epidemic of drink driving, distracted driving, and reckless driving in the USA—encouraged by the lack of police enforcement and by extremely lenient treatment by the courts—might also help explain the alarming rise in pedestrian fatalities since 2010.

8. Conclusions and Policy Recommendations

As documented in this paper, there are differences in rates of walking among countries, among cities in the same country, and in different parts of the same city. For all countries, the walking modal share of trips is much higher for short trips than for longer trips, although there is variation among countries in the rate of decline with increasing trip distances.

As part of our demographic analysis, we found that the percentage of walk trips made by women varied among countries only slightly (about 10%). Rates of walking remained high in all countries with increasing age. Indeed, in several countries, walk rates were higher for older age groups than for younger age groups, confirming the important role that walking plays in the mobility of older adults. In the three countries for which we could obtain comparable income data, walking rates were highest in the lowest income category and declined with increasing income. Similar to the case of older adults, this trend highlights the crucial importance of walking in the mobility of lower-income groups. Thus, along all three of the socioeconomic dimensions we examined, walking is a socially equitable means of transport.

The variation among countries summarized in the preceding paragraph must be interpreted with caution. As we note in the data and methods section of this paper, we used the best and most recent national travel surveys available for each of the countries. Nevertheless, the surveys vary in their timing, data collection techniques, variable definitions, methodology, and sample sizes. Thus, we recommend cooperation among the national transport ministries of countries in the design and timing of their travel surveys to make them more comparable and to increase the dependability of cross-country analysis.

Analyzing official government data, we also found considerable variation among countries in walking safety. The most important difference, by far, is the much more dangerous walking in the USA compared with the other countries we examined. Pedestrian fatality rates per 100,000 million km walked are five times higher in the USA than in the UK and 7–10 times higher in the USA than in Germany, Denmark, and the Netherlands. Moreover, walking has become much more dangerous in the USA since 2010, whereas it has become slightly safer in the other countries. That is not just a transport problem but a public health problem, most obviously in terms of pedestrian injuries and fatalities. Indirectly, dangerous walking conditions in the USA are also a problem because they discourage walking and thus deprive many Americans of the valuable physical, mental, and social health benefits of walking.

We identified a range of government policies that would encourage more walking while improving pedestrian safety. Cities that have successfully raised walking levels while improving pedestrian safety have implemented many of the measures listed here:

- The provision of an integrated network of wide, well-maintained, attractive, comfortable, accessible, and safe walking facilities.
- The design of roadways and intersections sensitive to the needs of pedestrians, with special provisions such as safety islands at intersection corners and at medians of roadway crossings, as well as well-lit, well-marked crosswalks indicating pedestrian priority.
- Housing and commercial developments are explicitly designed to take pedestrians into account, not only through the provision of walking facilities but also through local government regulations encouraging mixed uses, multiple commercial subcenters, pedestrian-friendly street design, and pedestrian cut-thrus to shorten walking distances and increase safety.
- Speed limits have been reduced city-wide on most streets, but especially in commercial districts and residential neighborhoods. Lower speed limits are strictly enforced by the police, speed cameras, and roadway infrastructure modifications that force motor vehicles to slow down and discourage thru traffic.
- The overall supply of on-road parking has been reduced, combined with restrictions on duration of parking, increased hourly rates, and resident-only parking in some neighborhoods.
- Traffic laws have been revised to give priority to pedestrians in most instances, requiring motorists to yield, and making motorists liable for pedestrian injuries in most crashes. The legal priority of pedestrians requires motorists to take special care to avoid endangering pedestrians. Police and courts strictly enforce these laws as well as laws regarding speed, dangerous driving, and distracted driving.
- Traffic education of both motorists and non-motorists is extensive and strict, starting in the schools and then in motorist training programs and testing to obtain a driver's license.
- Taxes on petrol as well as motor vehicle purchase and ownership have been increased to discourage large fuel-inefficient vehicles, with vehicle taxes based on vehicle size and power, not simply price. Regulations (such as in London) also include requirements for large vehicles to be equipped with cameras alerting drivers to the presence of pedestrians and cyclists.
- Although laws in many countries, states, and cities already prohibit drink driving and distracting driving, those laws should be much more strictly enforced, especially in the USA, where enforcement of traffic laws is so lax that they are often ignored by motorists, leading to speeding, reckless driving, drink driving, and distracted driving (e.g., mobile phone use).

As noted throughout this paper, the necessary government policies, laws, and regulations have already been in effect in many cities throughout Europe and increasingly in the USA, Canada, and Australia. Their success at increasing walking levels while improving pedestrian safety has been proven over decades of experience since the 1970s, when they were first implemented. Thus, it is mainly a matter of generating the necessary public and political support to implement these policies more widely and to a greater extent, especially in car-oriented countries such as the USA, Canada, and Australia. As noted at the outset of this paper, there are many good reasons to promote more and safer walking, but a massive public information and lobbying campaign will be necessary. European cities provide many practical examples of ways to increase walking and improve walking safety.

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