ENVIRONMENTAL RESEARCH
COMMUNICATIONS

PAPER • OPEN ACCESS

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To cite this article: Johanna Raudsepp *et al* 2024 *Environ. Res. Commun.* **6** 095002

Environmental Research Communications

CrossMark

OPEN ACCESS

RECEIVED
15 January 2024

REVISED
13 August 2024

ACCEPTED FOR PUBLICATION
20 August 2024

PUBLISHED
3 September 2024

PAPER

Travel footprints in the nordics

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Keywords: travel emissions, transport, climate concern, carbon footprint, GHG emissions

Supplementary material for this article is available online

Abstract

This study provides analyses of carbon footprint survey data from about 7500 respondents in the Nordics to present an overview of Nordic personal travel footprints. The study considers the spatial distribution of travel footprints, the influence of climate concern, and how the footprints fit within the 1.5-degree compatible threshold for 2030. Spatial variability from urban to rural areas differed from country to country. Low climate concern was linked to higher local and long-distance travel emissions. Travel footprints in all countries exceed the recommended threshold level, indicating a need for rapid action to reduce travel emissions in upcoming years. Moreover, there are indications that people who currently meet the threshold could belong to lower socio-economic groups, raising concern about meeting the travel needs of everyone. The study further highlights the context-dependence of the transport sector, even among countries with a similar background, which should be considered in mitigation policy.

1. Introduction

Climate change is transforming our world, owing greatly to anthropogenic activity, primarily fossil fuel combustion (Steffen *et al* 2018). With emissions still rising in most countries, the world is currently on a trajectory of a 3 °C temperature rise within this century and faces extreme weather events more frequently than before (UNEP 2021). After a temporary drop in 2020 due to the COVID-19 pandemic, fossil fuel emissions returned to pre-pandemic levels and are predicted to grow in 2023 (Friedlingstein *et al* 2023).

The transport sector is one of the largest contributors to global emissions. Globally, an estimated 20% of CO_2 emissions come from transport (Lamb *et al* 2021). The largest input comes from passenger cars and vans. Over a quarter of total direct GHG emissions in Europe can be attributed to transport (Buysse *et al* 2021), and it is the only European sector whose emissions have grown since 1990 (European Commission 2021). Transport in the tourism sector accounts for 22% of global transport-related emissions. Tourism's transport-related CO_2 emissions are expected to increase by 25% from 2016 levels by 2030 (World Tourism Organization & International Transport Forum).

In Europe in 2021, the predominant mode of travel for tourism was by motorised vehicles, such as cars and motorcycles, accounting for 74.7% of all trips, whereas air travel was 7.7%. Domestic trips were mainly made using land transport (97% of all domestic trips). However, 38.4% of trips abroad were made by air and 59.4% by land, mainly using motorised vehicles (car, motorcycle) (50.4% of total foreign trips) (Eurostat 2023). UNWTO predicts air travel to be the predominant method of transport for intra-regional tourism, followed by cars (UNWTO 2019).

GHG emissions from transportation in the Nordic countries - Sweden, Norway, Denmark, Iceland and Finland - are much higher than the global average (IEA 2018). Transport is reported to form 20%–47% of national footprints in the Nordics (Ministry of Transport and Communications of Finland 2021, Madkour, 2021, Morgado Simões and Seppälä 2021, Norwegian Ministry of Transport 2021, Grythe and Lopez-

Aparicio 2021, Regeringen och Regeringskansliet 2021, Statistics Iceland 2023). It should be noted that these numbers consider domestic transport consumption but do not consider footprints from international travel, which is a known large-scale contributor to global GHG emissions.

When looking at consumption-based emissions, which allocate the emissions to the end consumer (Baynes and Wiedmann 2012), transport emissions (personal transport and leisure) range from 24%–29% of a household's carbon footprint (Ivanova *et al* 2016) in Denmark, Sweden, Norway and Finland, and up to 33% in Iceland (Clarke *et al* 2017).

Several known variables contribute to the carbon footprints of personal transport - distances travelled, mode of transport, fuel or energy use, which are indirectly shaped by socio-demographic background, income levels, urban form, and other factors. Nordic countries have displayed hypermobility in international travel, where reductions of travel-related emissions are not dependent solely on income or affordability (Sovacool *et al* 2018, Czepkiewicz *et al* 2019), although higher income has been linked to higher emissions from both local travel and increased participation in travel abroad (Árnadóttir *et al* 2019). University education has been linked to higher mobility (Czepkiewicz *et al* 2019) and higher international travel emissions (Árnadóttir *et al* 2019). Nordic residents are likely to travel abroad for leisure at least once a year, with older individuals travelling as frequently as young people (Larsen *et al* 2023). In 2021, most Nordic leisure trips were domestic (81%–94.3% of all trips; data excludes Iceland). Engagement in tourism in the Nordics is higher (over 75%) than the EU average (55.9%) (Eurostat 2023).

Although urban density and compactness have been linked with lower levels of car use and emissions from local travel (e.g., Mindali *et al* 2004, Næss 2012), the degree of urbanisation has been found to have a positive relationship with total travel emissions (Brand and Preston 2010, Ottelin *et al* 2014, Reichert *et al* 2016, Große *et al* 2018), particularly in the highly mobile Nordic context (Czepkiewicz *et al* 2018, Czepkiewicz *et al* 2019, Árnadóttir *et al* 2019). Local travel emissions are typically higher in rural settings, owing largely to car use, whereas long-distance travel emissions increase in urban settings, largely due to higher rates of air travel (Reichert *et al* 2016, Czepkiewicz *et al* 2018, Ottelin *et al* 2019, Árnadóttir *et al* 2019, Czepkiewicz *et al* 2019, 2020a). Air travel significantly contributes to leisure travel emissions (Sharp *et al* 2016, Czepkiewicz *et al* 2019, 2020a).

The association between climate concern and carbon footprint has typically received little attention in previous studies due to a lack of data availability. Nässén *et al* (2015) concluded that the importance of pro-environmental attitudes is minimal in general carbon footprint reductions in Sweden. More recently, a study in Sweden found climate concern to be associated with footprint reductions (Andersson and Nässén 2023). In the mobility domain, studies in the UK (Alcock *et al* 2017) and the Nordics (Árnadóttir *et al* 2019, Czepkiewicz *et al* 2019) have found a *positive* relationship between environmental concern and GHG emissions from travelling abroad, particularly from flying. In recent years, the public debate in Sweden and beyond started problematising and moralising emissions from flying (Becken *et al* 2021), and some studies documented the process of giving up flying by climate-concerned people in Sweden (Jacobson *et al* 2020, Wormbs and Wolrath Söderberg, 2021). Aasen *et al* (2022) reported a very weak indirect *negative* relationship between climate concern and flying from Norway to Europe for leisure. There is, however, a need for more quantitative studies on whether elevated levels of climate concern correlate with reduced emissions from long-distance travel.

Climate concern is more likely reflected in reduced emissions from local travel. Previous studies have found a negative association between pro-environmental attitudes and the choice of active travel modes and lower levels of personal car use (Árnadóttir *et al* 2019) and an indirect positive association between climate change scepticism and conventional car ownership and use in Norway (Thøgersen *et al* 2021).

While many countries' climate action plans lack ambition (UNEP 2021), Nordic countries are said to have set somewhat of an example working towards maximum 1.5C warming targets (Greaker *et al* 2019). Yet, one of the biggest challenges for the Nordics is emissions reductions from the transport sector on both domestic and international scales (Greaker *et al* 2019, Salvucci *et al* 2019). European cumulative transport emissions by 2050 are expected to burn up around 6% of the remaining global carbon budget (under a high ambition scenario) for a chance to stay within 1.5-degree warming (67% likelihood scenario) (Buysse *et al* 2021, Buysse and Miller 2021, IPCC 2022).

Although the transport sector is one of the most challenging to decarbonise globally due to continuously rising demand and reliance on fossil fuels (Lamb *et al* 2021), it has one of the highest mitigation potentials (Ivanova *et al* 2020). In the Nordics, this is supported by low-carbon energy mixes, which make EV adoption a viable option for decarbonizing in several Nordic states (Dillman *et al* 2021a). However, sufficiently reducing transport emissions also requires car ownership reductions, due to indirect emissions associated with car manufacturing (Dillman *et al* 2021b). On the other hand, the climate policies of the Nordics have received criticism for showing results of limited or insignificant decoupling (Bhowmik 2019) and being country-centric (Greaker *et al* 2019, Salvucci *et al* 2019, Tilsted *et al* 2021). In addition, due to the current technical limitations of

Table 1. Number of full responses from each country and survey languages available.

Country	No. of complete responses	Final no. of responses	Language versions available
Sweden	2032	1982	Swedish, Finnish, English
Finland	2134	2084	Finnish, Swedish, English
Norway	1333	1326	Norwegian, English
Denmark	516	515	Danish, English
Iceland	1667	1553	Icelandic, Polish, English
TOTAL	7682	7460	

decarbonizing the aviation sector within the next few decades (Viswanathan and Knapp 2019, Schäfer *et al* 2019), demand-side reductions in this domain are crucial yet often ignored (Bhowmik 2019).

Considering the aforementioned and the critiques towards single-country approaches in achieving unified global goals (Greaker *et al* 2019, Tilsted *et al* 2021), this study examines the Nordic countries as a group due to their similar cultural, social and economic background (Olafsson 2013, Tiemer 2018). It has three main aims. Firstly, to provide an overview of the travel-related emissions of our sample in the Nordic countries based on reported engagement in travel. Although studies on travel emissions have been conducted before, they have mostly been limited to a single-country perspective. Secondly, the study examines the influence of residential location and climate concern on travel-related footprints. The study contributes to the limited literature on climate concern and carbon footprints. Lastly, the study provides a novel perspective by examining the recommended thresholds for a 1.5-degree compatible travel lifestyle (Akenji *et al* 2021), and how the Nordic countries are currently meeting the threshold. The perspective stems from the critique towards the sufficiency of Nordic climate policies (Bhowmik 2019).

The study shows that Nordic travel footprints exceed the suggested limits for 1.5-degree compatible living, highlighting concerns about the effectiveness of local and regional climate policies regarding travel, particularly long-distance travel. At the same time, despite generally high incomes and relatively low wealth inequality in the Nordics, the results indicate inequalities in mobility levels between socio-demographic groups.

2. Methods and data

2.1. Survey

The data consists of around 8000 responses from the five Nordic countries (Sweden, Finland, Norway, Denmark, Iceland) gathered from Fall 2021 to Spring 2022 using an online carbon footprint survey and calculator compiled by the authors, as described in detail in Heinonen *et al* (2022). The calculator takes a consumption-based approach (e.g., Baynes and Wiedmann 2012) and utilises the Personal Carbon Footprint method (Heinonen *et al* 2022), tailored to each country's context, where the emissions resulting from the consumption of goods or services are allocated to the consumer regardless of where the consumption takes place. The survey targeted adults aged 18 and over living in the Nordics.

The survey was available in the main official languages of each country, plus English in every country and Polish in Iceland. It was distributed on social media using the promotion service of a professional marketing company to target a broad scope of respondents. All participants consented to the study. The survey gathered various information about people's consumption habits within the 12 months before the survey. This study focuses on people's travel-related habits, both local and leisure travel, and environmental attitudes in the form of climate concern.

2.2. Sample overview

After erasing duplicates, incomplete answers, and impossible profiles, the sample included 7460 complete and acceptable responses from adult participants currently residing in one of the Nordic countries (table 1). Outliers were removed using the SPSS Anomaly Detection tool, followed by a manual assessment of response validity based on answers to a variety of survey questions.

An overview of the samples is given in table 2. It should be noted that representativeness was not a key target during data collection, but the discussion section will address the issue.

2.3. Estimation of GHG emissions

The calculations of footprints in this study are based on a consumption-based approach (e.g. Baynes and Wiedmann 2012) where the footprint is allocated to the person purchasing a good or using a service regardless of where the purchase takes place or where emissions are generated (Heinonen *et al* 2022). Hence, this study

Table 2. Overview of sample distribution across socio-demographic variables.

		Sweden	Finland	Norway	Denmark	Iceland
Gender	Male	34.3%	29%	46%	28.5%	47.1%
	Female	63.8%	68.3%	52.7%	68.6%	51.4%
	Genderqueer/other	1.9%	2.7%	1.3%	2.9%	1.5%
Average age		54	50	51	47	43
Age groups	18–25	79 (4.0%)	122 (5.9%)	55 (4.1%)	32 (6.2%)	138 (8.9%)
	26–35	209 (10.5%)	324 (15.5%)	211 (15.9%)	94 (18.3%)	397 (25.6%)
	36–45	272 (13.7%)	358 (17.2%)	170 (12.8%)	114 (22.1%)	353 (22.7%)
	46–55	439 (22.1%)	380 (18.2%)	282 (21.3%)	121 (23.5%)	287 (18.5%)
	56–65	604 (30.5%)	451 (21.6%)	349 (26.3%)	79 (15.3%)	230 (14.8%)
	65+	379 (19.1%)	449 (21.5%)	259 (19.5%)	72 (14.0%)	148 (9.5%)
Average household size		2.18	2.14	2.27	2.46	2.78
Average monthly income (personal, €[a])		2,773	2,564	3,597	3,748	3,780
Education level	basic	4.1%	6.5%	1.4%	4.5%	6.1%
	secondary	22.6%	9.4%	11.5%	8.9%	15.9%
	vocational	8.5%	29%	15.1%	12.4%	13.8%
	undergraduate	22.6%	24.9%	31.5%	26%	28.3%
	graduate	36.9%	26.6%	34.2%	38.1%	32%
	postgraduate	5.3%	3.7%	6.3%	7.4%	3.9%

[a] The survey year 2020 currency average exchange rates were: SEK/EUR = 10.4865; NOK/EUR = 10.7238; ISK/EUR = 154.59; DKK/EUR = 7.4543 (European Central Bank, 2021).

Table 3. Average car occupancy rates weighted by household size (based on Pucheanu *et al* 2020).

Household size	Local travel occupancy rate	Long-distance travel occupancy rate
Single person household	1	1
Two-person household	1.33	1.85
Three-person household	1.67	2.32
More than three-person household	2	2.78

focuses on personal travel-related aspects of the carbon footprint, which includes all motorized long-distance travel for purposes unrelated to work, and local travel for all purposes. We define long-distance travel as travel away from one's region of residence for leisure purposes. This excludes work-related travel as, based on the consumption-based accounting, work-related emissions are assigned to the employer. Further, local travel is defined within the scope of the study as day-to-day travel within one's local region, typically for commuting to work/school or for reaching regular activity locations (shops, services, etc). A statistical overview of travel footprints is provided in appendix (table A2).

2.3.1. Local travel

For local travel, respondents were asked to report their use of public transport and car as average kilometres per week. One average intensity of 0.12 kgCO2eq/pkm for public transport was calculated based on indirect emissions from Chester and Horvath (2009) and direct emissions from VTT Technical Research Centre of Finland (2021). The respondents were also asked to list the motorised vehicles in their possession, including type, size, power source, and (fuel) efficiency. It was assumed that the first reported vehicle was the most used vehicle of the respondent, and therefore, its characteristics were used to calculate emission coefficients for local motorized travel. Car emissions were divided by the average occupancy rate (table 3), calculated based on Pucheanu *et al* (2020).

The emissions factors per combusted litre were calculated using values from Cherubini *et al* (2009), including both the direct and the indirect emissions, and for EVs (assumed efficiency 12.5 kWh/100 km) according to electricity in each country, similarly including the direct and the indirect emissions, displayed in table 4.

Table 4. Fuel coefficients used for different fuel types.

Fuel type	Coefficient
Gasoline	3.003 kg CO2e/liter
Bioethanol (sugarcane and other crops)	1.003 kg CO2e/liter
Diesel	3.189 kg CO2e/liter
Biodiesel (rapeseed, soy, sunflower)	1.732 kg CO2e/liter
Natural gas	3.761 kg CO2e/liter
Biogas	1.382 kg CO2e/liter
Electricity	Sweden: 67 gCO2e/kWh Finland: 209 gCO2e/kWh Norway: 18 gCO2e/kWh Denmark: 199 gCO2e/kWh Iceland: 19 gCO2e/kWh

Table 5. Statistical overview of local travel footprints across Nordic countries.

	N	No. of zeroes	Mean	STDV	25th percentile	Median	75th percentile	Kurtosis	Skewness
Iceland	1553	98	1257	1801	176	656	1514	60.50	5.45
Finland	2084	135	1201	1668	250	656	1474	25.76	3.99
Norway	1326	83	1171	1945	125	543	1475	45.52	5.26
Denmark	515	35	1104	1476	195	581	1493	11.74	2.93
Sweden	1982	152	1091	1692	187	562	1287	35.01	4.74

Table 6. Round-trip distances and emission factors used to calculate reported long-distance travel.

	Short range	Medium range	Long range
Ferry	2 × 250 km 0.36 kgCO2e/pkm	2 × 1140 km 0.36 kgCO2e/pkm	2 × 4000 km 0.36 kgCO2e/pkm
Plane	2 × 500 km 0.34 kgCO2e/pkm	2 × 2000 km 0.28 kgCO2e/pkm	2 × 8000 km 0.28 kgCO2e/pkm
Train	2 × 500 km 0.08 kgCO2e/pkm	2 × 2000 km 0.08 kgCO2e/pkm	2 × 4000 km 0.08 kgCO2e/pkm
Bus	2 × 500 km 0.15 kgCO2e/pkm	2 × 2000 km 0.15 kgCO2e/pkm	2 × 4000 km 0.15 kgCO2e/pkm
Car	2 × 500 km Emission factor calculated by fuel type	2 × 2000 km Emission factor calculated by fuel type	2 × 4000 km Emission factor calculated by fuel type

Annual local travel footprint was calculated using the following formula:

$$\begin{aligned}&\textit{Local travel footprint}\,(\textit{annual})\\&=\left(\frac{\textit{km travelled weekly by car}}{\textit{occupancy rate}}\right)*\textit{fuel coefficient}*\textit{fuel consumption per } 100\textit{km}*52\textit{ weeks}\\&+\textit{km travelled by public transport}*\textit{public transport coefficient}*52\textit{ weeks}\end{aligned}$$

The local travel footprints in our samples were positively skewed and leptokurtic (table 5). For analysis, it was assumed that all respondents travel locally, with zero values indicating active travel only. The means are strongly influenced by extreme high values, as evidenced by standard deviation and median values. To limit the influence of these high value outliers and zeroes in regression analysis, local travel footprint was transformed using natural logarithm.

2.3.2. Long-distance travel

The survey respondents were asked to report the number of long-distance trips in the short (0–1000 km), medium (1000–3000 km) and long range (3000+ km) they had taken in the previous 12 months using a ferry, plane, train, bus or car. The emission factors per person per passenger kilometre were calculated based on Chester and Horvath (2009) and Aamaas *et al* (2013), assuming typical occupancy (table 6, see also table 3). The

Table 7. Most common car type, fuel type and fuel use in each country based on mode.

Country	Car type	Fuel type	Fuel use (L/100 km)
Finland	Medium car	gasoline	7.00
Iceland	Medium car	gasoline	7.00
Sweden	Medium car	gasoline	5.00
Norway	Medium car	diesel	5.00
Denmark	Medium car	gasoline	5.00

Table 8. Statistical overview of long-distance travel footprints across Nordic countries.

	N	No. of zeroes	Mean	STDV	25th percentile	Median	75th percentile	Kurtosis	Skewness
Iceland	1553	282	2159	3650	160	1120	2661	15.32	3.26
Finland	2084	440	1728	7194	114	649	1819	1137.86	30.76
Norway	1326	387	1770	7361	0	450	1739	449.42	18.88
Denmark	515	135	1821	2861	0	845	2316	26.55	3.92
Sweden	1982	674	1391	6826	0	259	1134	313.33	16.28

respondents were given an example for a trip within each distance band, tailored for every country, to improve their estimates for trips belonging to each category.

Respondents who did not report ownership of a vehicle but reported long-distance trips by car (most likely using a rental), were also accounted for using the most common fuel use for the most common fuel type in each country, as presented in table 7.

Annual long-distance travel footprint was calculated using the following formula:

$$\begin{aligned} &Long - distance\ travel\ footprint \\ &= no.of\ \ trips\ by\ ferry\ {}_{*}\ distance\ coefficient \\ &+ no.of\ \ trips\ by\ air\ {}_{*}\ distance\ coefficient \\ &+ no.of\ \ trips\ by\ train\ {}_{*}\ distance\ coefficient \\ &+ no.\ of\ \ trips\ by\ bus\ {}_{*}\ distance\ coefficient \\ &+ no.\ of\ \ trips\ by\ car_{**} \\ &\frac{(distance\ of\ \ roundtrip\ {}_{*}\ fuel\ coefficient\ {}_{*}\ fuel\ consumption\ per\ 100\ km)}{occupancy\ rate} \end{aligned}$$

The long-distance travel footprints in our samples were positively skewed and leptokurtic (table 8). The means are strongly influenced by extreme high values, as evidenced by standard deviation and median values. In comparison to local travel, long-distance travel had many zeroes (18%–34% of samples) due to people not engaging in long-distance travel. Therefore, long-distance travel was examined in two regression settings, as described in the statistical analysis section. To limit the influence of these high value outliers and zero values in linear regression analysis, long-distance travel footprint was transformed using natural logarithm.

2.4. Spatial variables

2.4.1. Degree of urbanisation

In the survey, respondents were asked to mark their home location on a map. Each home location was assigned a degree of urbanisation based on Eurostat classification categorised as cities/densely populated areas, towns and suburbs/intermediately populated areas, and rural/thinly populated areas (Dijkstra *et al* 2021). The degree of urbanisation was used as a variable in the statistical analyses to account for spatial differences.

2.4.2. Population density

Population density (1000 people/km2) was calculated based on the total population within the nearest 1 km2 grid cell based on population data in 2018 (Eurostat 2018).

2.4.3. Airport Access Index

The Airport Access Index (AAI) was used to assess whether living closer to well-connected airports influences one's long-distance travel footprint. The index considered the driving distance to five closest airports and the natural logarithm of the airport's connectivity based on the number of international flight connections in 2019.

Distance to the airports was calculated from each respondent's residential location based on the driving distance (using roads and ferry lines from EuroRegionalMap). The decay of attractiveness with increasing distance was modelled with an exponential function, similarly as in other airport accessibility studies (e.g., Rosik *et al* 2017).

2.5. Socio-economic background

2.5.1. Age

Respondents were asked to mark their age at the time of the survey as a continuous variable, which was later split into categories with 10-year intervals (except the lowest and highest categories).

2.5.2. Gender

Respondents were asked to choose gender from four options: male, female, non-binary/genderqueer, and other. For analysis, the mean footprints of each group were considered, and gender was merged into male and female with non-binary, genderqueer and other.

2.5.3. Education level

Education level was asked in six categories: basic, secondary, vocational, undergraduate, graduate, and postgraduate; and then merged into three groups: low education level (basic, secondary), a medium education level (vocational, undergraduate), and high education level (graduate, postgraduate).

2.5.4. Income level

The respondents were asked to report their personal and household income following the official income deciles in each country, but with the 10th decile split into two to better capture the most affluent. The income variable was calculated as the household income per capita, where the household income was divided by the number of people living in the household and then split back into the original personal income deciles based on the respondent's country of residence. Heinonen *et al* (2022) describe the variable in greater detail. For this study, the income level was divided into low (deciles 1–3), medium (4–7), and high (8–11) levels.

2.5.5. Household type

Respondents were asked about how many adults (including the respondent) and how many children were in the household. This was used to create a household type variable split into three categories: households with children, single-adult households, and multi-adult households.

2.5.6. Working time

In the survey, respondents could choose their employment status and time spent working and studying per week. The resulting variables were used to create the working time variable, which was coded into four categories: not working or unemployed, working part-time (<35 h/week), working full-time (35–45 h/week), and working overtime (>45 h/week). The variable creation is described in greater detail in Emilsdóttir (2023).

2.6. Climate concern

Climate concern was measured with questions derived from Chryst *et al* (2018) and supplemented with one question about the importance of climate change mitigation:

1. How worried are you about climate change?
2. How much do you think climate change will harm future generations?
3. How much do you think climate change will harm you personally?
4. How important is the issue of climate change to you personally?
5. How important is it to mitigate climate change?

The answers were provided a Likert scale of 1–5 where the scale was labelled as 'not at all', 'slightly', 'moderately', 'very', 'extremely' from lowest to highest values. The variable was constructed as a mean numeric value of the answers:

Since the relationship between climate concern and travel footprints was non-linear in some countries, the variable was divided into four groups: Low (under 2.5), Moderate (2.5–3.5), High (3.5–4.5) and Very high (over 4.5). The rationale behind creating the last group was to capture the potential influence of extreme concern on travel behaviour hypothesised by previous studies. In statistical analysis, the High climate concern group is used as the reference group as it represents the majority and the mean and median values fall into the boundaries of this group (see also table A1).

2.7. Statistical analysis

The statistical analysis was conducted in three phases. The first phase was a descriptive and bivariate overview of the travel footprints. Means, medians, and distributions across various categories are discussed.

The second phase began with examining the participation in long-distance travel using binomial logistic regression. It was assumed that all participants participate in local travel in some form, and participation was therefore not examined separately. Secondly, the total local and long-distance travel footprint was examined using multiple linear regression. Two variable settings were used. First, the long-distance and local travel footprints were transformed using a natural logarithm to reduce skewness, normalize the residual distribution, and reduce the influence of outliers on statistical analyses. It was then used to examine the effect of independent variables on the emission levels of those who participated in long-distance travel. The untransformed footprints were also analysed to assess the effect sizes in natural values (kg CO_2) without reporting significance levels.

In the third phase, the emissions in the sample were compared against the recommended 1.5-degree warming threshold level for travel by 2030 to assess who meets the target today (binomial logistic regression) and what contributes to the overshoot (multiple linear regression). The threshold was calculated based on Akenji *et al* (2021), in which 1.5-degree compatible per capita consumption-based footprint levels are presented based on the Paris Agreement. The threshold is derived from the Finnish case in the report to match better with the context of a wealthy Nordic society, which includes personal local and long-distance travel to the same extent as in this study. Therefore, the threshold level used in our study was 0.962 tCO2eq/cap/year by 2030 (Akenji *et al* 2021).

Overarching patterns were noted in the results tables in bold when three or more significant values in the same direction occurred (effect direction marked with ↑ or ↓).

3. Results

The average personal travel-related footprints were examined. Authors note that by nature, footprint data is positively skewed, and therefore the averages presented here should be considered with caution. Median values and other statistical parameters are provided in appendix (table A2).

The average travel-related footprints were 3.4 (Median: 2.2) tCO2eq in Iceland, 2.9 (Median: 1.7) tCO2eq in Finland, 2.9 (Median: 1.6) tCO2eq in Norway, 2.9 (Median: 1.9) tCO2eq in Denmark and 2.5 (Median: 2.7) tCO2eq in Sweden (figure 1(a)). Local travel formed 37%–44% and long-distance travel 56%–63%. Total travel footprint increased along the income levels in Iceland, Sweden, Finland and Denmark (both average and median footprint). In Norway, total travel footprints were similar across all income levels, with medium income level having the lowest mean total footprint (figure 1(b)).

Spatial variability was examined between urban, semi-urban and rural areas. Total travel footprint mean was the greatest among people residing in urban areas in Norway and Finland and residents of semi-urban areas in Sweden, Iceland and Denmark (figure 1(c)). However, when examining median values, in Norway there was not much difference (less than 0.1tCO2eq) between degree of urbanisation, and in Finland rural areas had the highest median total travel footprint (Median:1.8 tCO2eq) (table A3). The mean footprint was the lowest in urban areas in Sweden and Denmark, semi-urban areas in Norway and rural areas in Iceland and Finland (figure 1(c)). On the other hand, when examining the median values, urban areas had the lowest footprint in Iceland, Finland and Denmark, while in Sweden the differences between medians of total travel footprint ranged under 0.1 tCO2eq between the degrees of urbanisation (table A3).

A strong connection between climate concern and total travel footprint appeared in all Nordic countries - the more concerned about the climate, the lower the travel-related footprint. On average, people with low climate concern had vastly higher mean travel footprints than those with higher climate concern (nearly double or more). Having high versus very high climate concern resulted in relatively similar mean footprints across countries (figure 1(d)). When comparing median values, the same pattern stands in Iceland, Finland, Denmark and Sweden, although it should be noted that the vast difference could be explained by high emitters who mainly belong to low climate concern groups. In Norway, the footprint median varies across climate concern groups, with high climate concern having a higher median travel footprint than the medium concern group (table A3).

3.1. Local travel

The study assumes that all participants participate in local travel, and those who do not emit in this category can be assumed only to use active transport modes. The ratio of people only using active travel modes within our samples was about 6% in Iceland and Finland, 7% in Denmark and 8% in Norway and Sweden. On average,

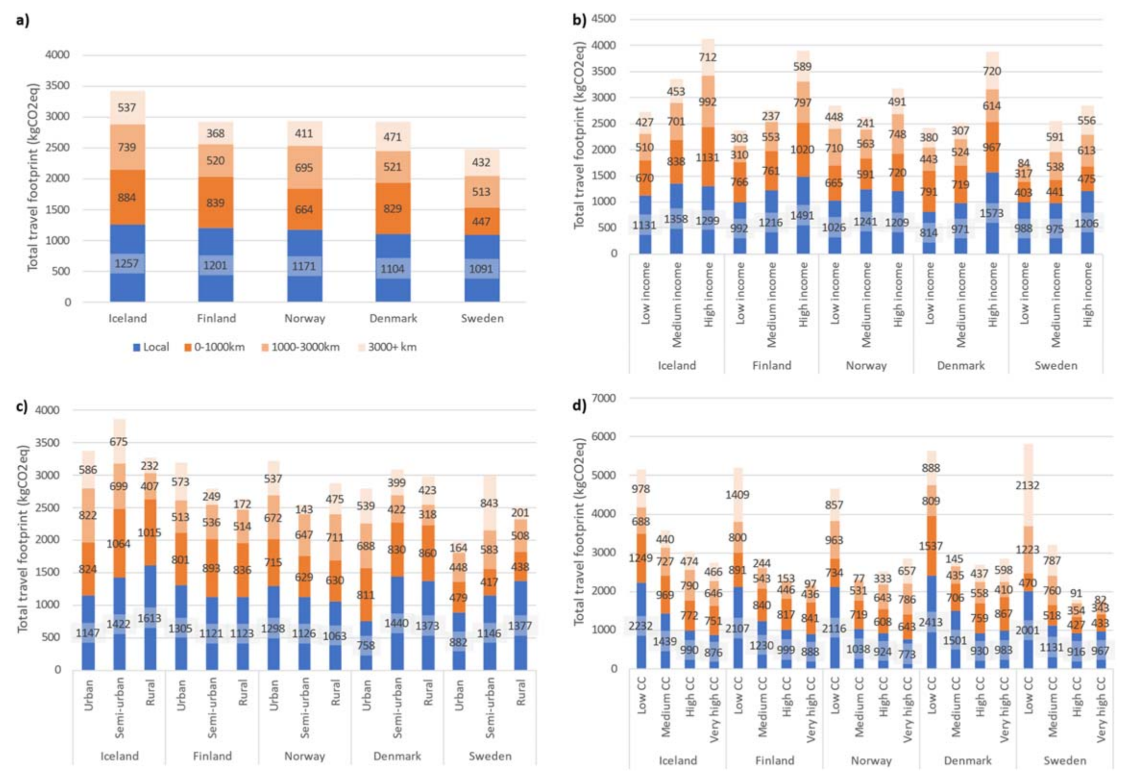

Figure 1. Travel footprint means in the Nordics (a) split into local and long-distance footprints, (b) distribution by income level, (c) distribution by degree of urbanisation, and (d) distribution by level of climate concern (CC).

people did most of their local commuting by car - the mean weekly distance driven was 119.4km in Sweden, 124.6 km in Denmark, 135.2 km in Finland, 148.8 km in Norway and 156.6 km in Iceland. Meanwhile, with public transport, people covered an average weekly distance of 16.9 km in Iceland, 35.2 km in Finland, 49.4 km in Denmark, 51.61 km in Norway and 54.4 km in Sweden. A statistical overview of averages is given in appendix (table A4).

Public transit emissions comprised 8%–31% of the local travel footprints. The mean local travel footprint was highest in Iceland (1.26 tCO2eq, Median: 0.66) and lowest in Sweden (1.09 tCO2eq, Median: 562) (figure 2(a)). Local travel footprint was dominated by car emissions, making up 69%–92% of total local travel emissions. The share of public transport footprint was highest in Sweden (0.34 tCO2eq) and lowest in Iceland (0.11 tCO2eq), whereas car footprints followed the opposite pattern (figure 2(a)). Local travel footprint varied between income groups between countries. In Finland and Denmark, mean local travel footprint was the highest for high income and vice versa (figure 2(b)), but when looking at medians the pattern also occurred in Sweden and Norway (table A4). In Iceland and Norway, the medium income level indicated higher mean emissions compared to the other two groups (figure 2(b)), but median values indicate the same pattern only in Iceland with little variance between low and high income groups (table A4).

The spatial distribution showed that in Iceland and Sweden, mean and median local travel footprint was highest in rural areas and lowest in urban areas. In Norway and Finland, the opposite pattern appeared, where living in an urban area was associated with higher emissions, and semi-urban and rural areas had lower emissions (figure 2(c)). However, when looking at median values in Norway and Finland, there were minimal differences (under 0.1 tCO2eq) between the degrees of urbanisation (table A4).

Climate concern followed a clear pattern in all five countries, where low climate concern indicated higher mean and median local travel emissions compared to other groups, gradually decreasing the higher the climate concern, with minimal differences between high and very high climate concern (figure 2(d); table A4).

Local travel emissions were examined in a multiple linear regression setting. Young age (under 25) compared to 65+ was positively associated with local travel emissions in Iceland, Finland, Norway and Sweden (effect range +0.3 to +0.9 tCO2eq) but negatively associated in Denmark. Living alone (single adult household) was associated with higher local travel emissions in Iceland, Norway and Sweden compared to households with children (effect range +0.4 to +0.7 tCO2eq). Not working or studying was negatively associated with local travel emissions in Finland, Denmark and Sweden but positively associated in Iceland (table 9).

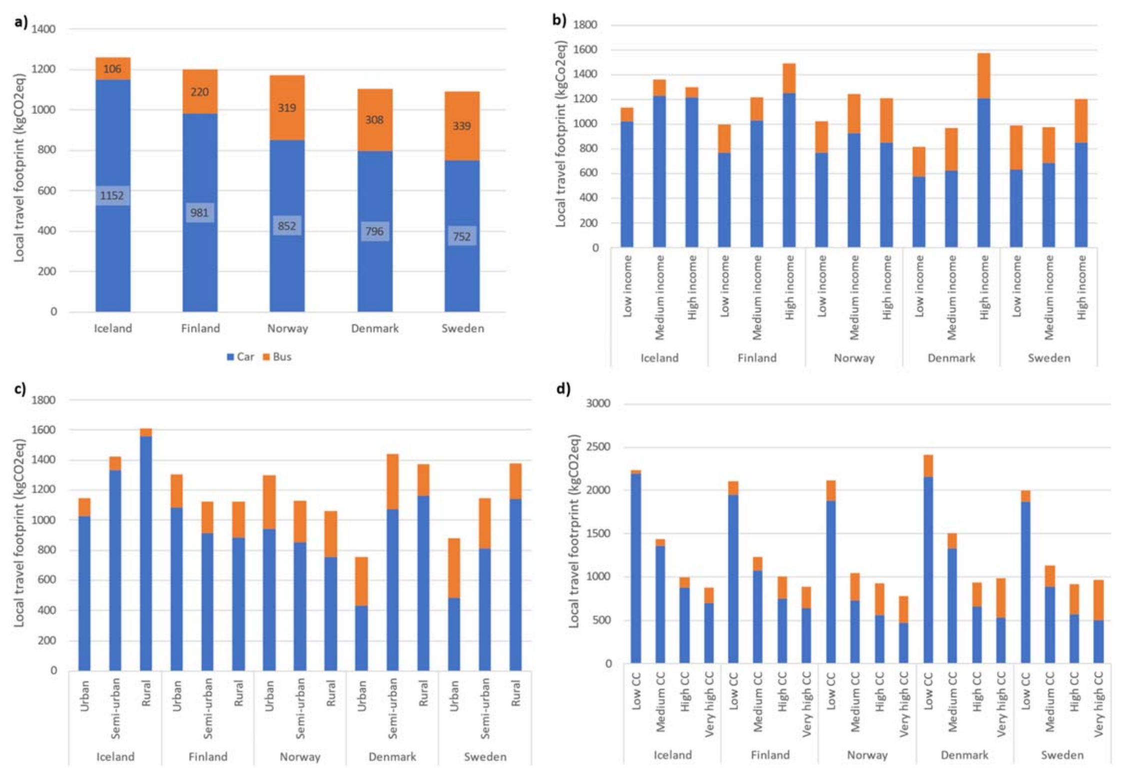

Figure 2. Local travel footprint means in the Nordics (a) split by mode, (b) distribution by income level, (c) distribution by degree of urbanisation, and (d) distribution by level of climate concern (CC).

Population density was a significant variable connected to lower local emissions in Iceland, Finland and Denmark. However, the effect was less than 0.1 tCO2eq less per every added 1000 people living in a km2 range. Most notably, low and medium climate concern indicated higher local travel emissions at a significant level across the countries, associated with up to +1 tCO2eq compared to high climate concern (table 9).

3.2. Long-distance travel

The long-distance travel participation rate was about 82% in Iceland, 78% in Finland, 67% in Norway, 74% in Denmark and 65% in Sweden. Respondents reported an average number of leisure trips of 7.9 in Iceland, 8.1 in Finland, 6.4 in Norway, 7.5 in Denmark and 5.1 in Sweden. Of those trips, the majority were short-range leisure trips. The mean footprint from long-distance leisure travel was the highest in Iceland (2.2 tCO2eq, Median:1.1 tCO2eq) and lowest in Sweden (1.4 tCO2eq, Median: 0.3 tCO2eq). Median values and a general statistical overview of the footprints is provided in appendix (table A5).

Most emissions in long-distance travel come from air and car travel in all five countries. In Iceland, Finland and Sweden, emissions from car travel were the biggest contributor to the footprint (figure 3(a)). Mean and median long-distance travel footprints followed the income gradient in Sweden and Finland. In Norway and Denmark, the medium-income group had the lowest mean long-distance footprint, but when examining median values, in Denmark the footprint pattern followed the income gradient. Low income levels in Sweden were related to a particularly low long-distance travel footprint (0.8 tCO2eq, Median: 0.16) (figure 3(b); table A5).

The spatial distribution of the long-distance footprint varied between countries. In Finland and Denmark, urban dwellers emitted the most and rural dwellers the least. In Iceland and Sweden, living in a semi-urban area indicated a notably higher mean long-distance travel footprint. In Norway, semi-urban dwellers emitted the least in this category (figure 3(c)). When examining the median values, in Finland and Norway, urban dwellers emitted the least and rural dwellers the most, while the opposite pattern was noted for Iceland, Denmark and Sweden (table A5).

When examining average footprints in climate concern groups, a clear trend emerged in all five Nordic countries - people with low climate concern had notably higher long-distance travel footprints compared with other groups. In Norway and Denmark, high and very high climate concern was associated with higher long-distance travel footprint than medium concern. (figure 3(d)). In Sweden, Norway, and Finland, high average

Table 9. Local travel emissions, multiple linear regression. Model 1b: ln-transformed local travel emissions for those who emit locally; Model 1c: local travel emissions (kgCO2eq) for whole sample (sig. level not indicated due to possible overinflation). Variables that are significant in the same direction 3 or more times across countries are marked in bold, with the arrow direction indicating the effect on the emissions. Significance levels: $p < 0.01$ ***, $p < 0.05$ **, $p < 0.1$ *.

		ICELAND		FINLAND		NORWAY		DENMARK		SWEDEN	
		1b	1c	1b	1c	1b	1c	1b	1c	1b	1c
		n = 1455	n = 1553	n = 1949	n = 2084	n = 1216	n = 1297	n = 480	n = 515	n = 1831	n = 1982
Reference groups		β	B	β	B	β	B	β	B	β	B
	(Constant) (B)	5.525***	464.2	6.611***	1132.1	5.471***	511.1	6.664***	901.3	6.155***	578.5
Age 65+	**Age under 25 ↑**	0.184***	876.5	0.052*	661.2	0.068**	328.4	−0.129**	−445.4	0.071**	629.1
	Age 26–35	0.195***	533.0	−0.031	23.3	0.028	199.6	−0.072	−17.4	0.050	464.7
	Age 36–45	0.109**	535.0	0.008	34.5	−0.012	90.9	−0.081	−149.3	0.040	280.6
	Age 46–55	0.070	425.9	0.009	−11.8	0.047	111.1	−0.075	−164.9	0.057	261.2
	Age 56–65	0.050	289.9	0.015	86.6	−0.003	1.7	−0.027	99.9	0.061*	255.1
Medium education level	Low education level	0.040	162.0	0.014	92.4	0.038	226.8	0.007	50.8	0.019	36.9
	High education level	−0.014	45.8	−0.019	6.7	−0.002	−5.1	−0.002	47.5	−0.026	−54.1
Medium income level	Low income level	−0.008	−182.7	−0.074***	−242.7	0.000	−134.7	−0.069	52.3	−0.024	−21.4
	High income level	−0.061*	−95.5	0.072***	243.1	0.018	−126.8	0.093*	556.1	0.002	273.4
Female + genderqueer	Male	0.074***	319.8	0.032	134.1	0.012	240.0	0.128***	367.7	−0.010	11.9
Household with children	**Single adult household ↑**	0.149***	651.2	0.045	81.0	0.081**	488.9	0.089	208.4	0.162***	409.6
	Multi-adult household	0.067**	232.7	0.028	37.3	0.037	111.5	0.063	164.5	0.126***	308.1
Full-time (35–45 h)	**Not working/studying ↓**	0.060**	310.2	−0.147***	−452.3	0.051	−13.2	−0.103**	−206.9	−0.111***	−96.2
	Works part-time	−0.042	−93.4	0.023	−77.4	0.021	215.0	0.002	208.2	0.010	89.8
	Works overtime	0.050*	593.3	0.005	109.5	0.020	352.4	0.011	31.5	0.032	1560.6
Lives in urban area	Lives in urban area	−0.032	−120.5	0.008	147.0	−0.003	135.3	−0.190***	−413.9	−0.127***	−379.3
	Lives semi-urban area	−0.010	−66.6	−0.025	−54.0	0.037	68.0	−0.017	77.5	−0.080***	−213.5
	Population density ↓	−0.062**	−76.2	−0.182***	−67.1	0.032	9.8	−0.154***	−41.2	−0.032	−17.1
High climate concern	**Low climate concern ↑**	0.148***	996.5	0.217***	973.8	0.212***	1044.3	0.129***	1028.3	0.176***	945.4
	Moderate climate concern ↑	0.082***	354.2	0.061***	208.2	0.042	54.9	0.118***	475.7	0.067***	202.4
	Very high climate concern	−0.033	−177.9	−0.026	−108.9	−0.006	−161.5	0.103**	131.5	0.003	41.7
	R square	0.098	0.114	0.143	0.123	0.066	0.083	0.218	0.177	0.083	0.088
	Adjusted R square	0.085	0.101	0.134	0.114	0.049	0.068	0.182	0.142	0.072	0.078
	F-statistic	7.403**	9.334**	15.319**	13.789**	3.990**	5.497**	6.086**	5.051**	7.749**	8.962**
	Durbin-Watson	2.032	2.061	2.018	1.968	1.905	1.917	1.941	1.967	2.099	2.076

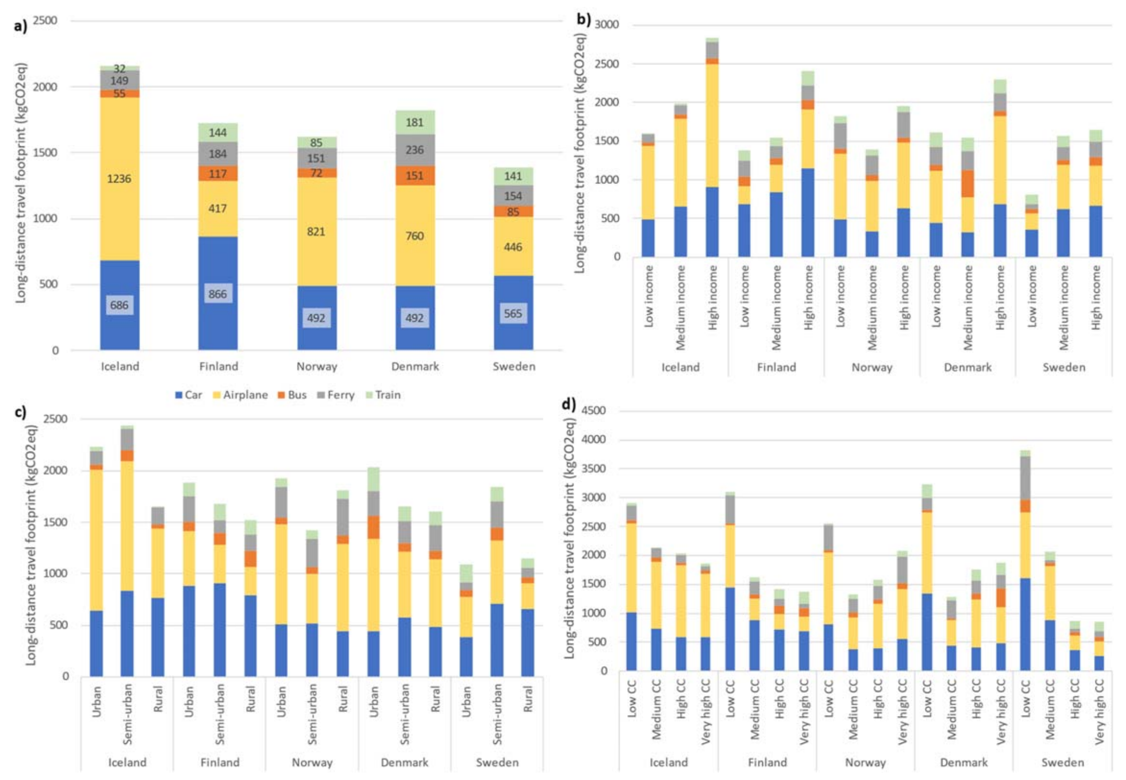

Figure 3. Long-distance travel footprint means in the Nordics (a) split by mode, (b) distribution by income level, (c) distribution by degree of urbanisation, and (d) distribution by level of climate concern (CC).

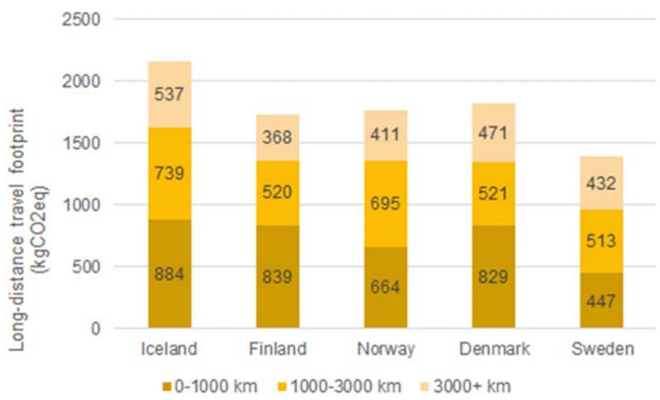

Figure 4. Long-distance travel footprint means in the Nordics split by round-trip distance bands.

values were driven by relatively few individuals with very high footprints, who predominantly reported low climate concerns. Median footprints in these countries were lower in the low concern group than in the high concern group. Although in Finland, the variability between climate concern groups was less than 0.1 tCO2eq. In Denmark and Iceland, median footprints in the low concern group were higher than in the high concern group (table A5).

Round trips of less than 1000 km contributed the most to long-distance footprints in Iceland, Norway, Finland, and Denmark. In Sweden, the footprint was relatively balanced between the distance bands (figure 4).

Participation in long-distance travel was examined using binomial logistic regression. Some main results are summarized here.

Influential variables in predicting long-distance travel participation varied between countries. However, some general patterns could be seen. Low education levels and single adult households were associated with a reduced likelihood of participating in long-distance travel compared to households with medium education levels and households with children, respectively. In addition to these overarching patterns, it was noted that the

Table 10. Participation in long-distance travel (Model 2a). Binomial logistic regression. Variables that are significant in the same direction 3 or more times across countries are marked in bold, with the arrow direction indicating the effect on the emissions. Significance levels: $p < 0.01$ ***, $p < 0.05$ **, $p < 0.1$ *.

Reference groups		ICELAND 2a n = 1546 Exp (B)	FINLAND 2a n = 2084 Exp (B)	NORWAY 2a n = 1326 Exp (B)	DENMARK 2a n = 515 Exp (B)	SWEDEN 2a n = 1982 Exp (B)
	(Constant) (B)	27.543***	9.562***	3.389***	7.006***	1.101
Age 65+	Age under 25	0.392**	2.158**	0.613	1.916	1.957**
	Age 26–35	0.407***	1.669**	0.893	0.608	1.786**
	Age 36–45	0.415**	1.677**	0.743	0.380**	1.537*
	Age 46–55	0.465**	0.948	1.095	0.844	1.293
	Age 56–65	0.471**	1.064	1.401	0.706	1.407**
Medium education level	**Low education level ↓**	0.789	0.563***	0.614***	0.606*	0.832
	High education level	1.134	1.272	1.255	2.185***	1.311**
Medium income level	Low income level	0.506***	0.698**	1.027	0.919	0.836
	High income level	1.057	1.482**	0.999	1.256	1.330**
Female + genderqueer	Male	0.642***	0.827	0.845	1.433	0.926
Household with children	**Single adult household ↓**	0.618**	0.561***	1.133	0.416***	0.831
	Multi-adult household	0.868	0.731*	1.012	0.436	1.269
Full-time (35–45 h)	Not working/studying	0.599**	0.513***	0.763	0.797	1.051
	Works part-time	0.862	0.923	1.038	1.032	1.242
	Works overtime	1.016	0.382***	0.417**	572215100.39	0.596
Lives in rural area	Lives in urban area	0.761	0.828	0.771	1.634	1.211
	Lives in semi-urban area	1.417	0.930	0.842	0.832	0.926
	AAI	0.935	1.077**	1.067	0.951	1.039
High climate concern	**Low climate concern ↓**	1.099	0.661**	0.647**	0.878	0.677**
	Moderate climate concern	0.999	0.834	0.750*	0.648	1.006
	Very high climate concern	1.010	0.814	0.835	0.579**	0.981
	Nagelkerke R square	0.069	0.165	0.076	0.169	0.081
	Chi-square	14.194	6.276	17.177**	10.299	6.362
	Omnibus test	66.628***	230.268***	69.068***	63.196***	116.911***
	% predicted correctly	81.70%	78.90%	70.10%	76.30%	66.30%

three age groups under 45 (compared to 65+) were associated with participation in multiple countries, although in varying directions. Low climate concern decreased the likelihood of participating in long-distance travel in Finland, Norway and Sweden, and very high climate concern was significantly linked to lower likelihood of participation in Denmark (table 10).

Long-distance travel emissions were examined using multiple linear regression in two steps. In the first step, long-distance travel emissions (transformed using natural logarithm) were analysed for those who participate in long-distance travel (Model 2b) to assess the direction of the effect. In the second step, untransformed emissions for long-distance travel were examined for all respondents (Model 2c) to assess possible effect magnitude. Due to possible overinflation of such footprint data, the significance levels are not reported.

Among socio-demographic variables, young age (under 25) was positively associated with long-distance travel emissions compared to people aged 65+ in Iceland, Finland and Norway among the people who travel. High income level was positively linked to long-distance travel emissions in Iceland, Finland, and Denmark. Single adult households were positively associated with emissions in all five countries, compared to households with children (table 11).

Low climate concern was associated with higher emissions in long-distance travel in all countries, although non-significant in Denmark. In addition, medium climate concern was positively associated with long-distance travel emissions in Iceland, Finland, and Sweden (compared to high climate concern). There was no significant link between very high climate concern and long-distance travel footprints when compared to the majority group (high climate concern) (table 11).

In summary, in Iceland, the largest positive effect on the long-distance travel footprint was from low climate concern, and the largest negative effect was from low education level (non-sig.). In Finland, the largest positive effect size was from low climate concern and the largest negative effect was from not working (non-sig.). In Norway, the largest positive effect size was among the age group under 25, while the largest negative effect was from working overtime (non-sig.). In Denmark, the largest positive effect size was from low climate concern and the largest negative effect was from low education level. In Sweden, the largest positive effect on emissions was

Table 11. Long-distance travel footprint, multiple linear regression. Model 2b: ln-transformed long-distance travel emissions for those who participate in long-distance travel; Model 2c: long-distance travel emissions (kgCO2eq) for whole sample (sig. level not indicated due to possible overinflation). Variables that are significant in the same direction 3 or more times across countries are marked in bold, with the arrow direction indicating the effect on the emissions. Significance levels: $p < 0.01$ ***, $p < 0.05$ **, $p < 0.1$ *.

		ICELAND		FINLAND		NORWAY		DENMARK		SWEDEN	
		2b	2c	2b	2c	2b	2c	2b	2c	2b	2c
		n = 1265	n = 1546	n = 1627	n = 2057	n = 890	n = 1255	n = 379	n = 514	n = 1289	n = 1949
Reference groups		β	B	β	B	β	B	β	B	β	B
	(Constant)	6.015***	1078.1	6.392***	1013.8	6.213***	1310.2	6.860***	1242.4	5.786***	−210.2
Age 65+	**Age under 25 ↑**	0.130***	−69.8	0.075**	491.7	0.114***	2636.2	0.054	1265.7	0.057	2022.7
	Age 26–35	0.151***	−67.9	−0.016	−357.2	0.038	590.5	0.016	448.8	0.009	−125.2
	Age 36–45	0.082	−202.0	−0.032	−328.6	−0.086*	−990.8	0.048	294.5	−0.029	−236.2
	Age 46–55	0.082*	−255.2	−0.072*	−528.5	0.012	−196.9	0.054	623.5	−0.061	−600.0
	Age 56–65	0.096**	731.7	−0.025	280.7	0.021	79.9	−0.028	−55.1	−0.013	282.7
Medium education level	Low education level	−0.062*	−309.1	−0.040	−351.8	−0.037	−498.2	−0.095	−1060.8	−0.062*	181.7
	High education level	−0.021	21.8	0.041	724.8	0.068*	945.3	−0.067	−154.9	0.031	513.7
Medium income level	Low income level	0.005	−156.0	−0.015	−34.6	0.019	260.2	0.039	11.7	−0.039	−940.5
	High income level ↑	0.066*	625.5	0.062**	472.5	0.012	811.9	0.127*	567.0	−0.006	417.4
Female + genderqueer	Male	−0.040	−89.1	−0.016	223.7	−0.012	571.1	−0.030	49.6	0.026	12.0
Household with children	**Single adult household ↑**	0.161***	668.0	0.260***	538.4	0.131***	−236.7	0.232***	907.3	0.252***	609.9
	Multi-adult household	0.032	229.9	0.148***	432.3	0.002	−820.3	0.081	23.0	0.161***	567.7
Full-time (35–45 h)	Not working/studying	0.061*	100.6	−0.046	−683.1	0.031	−289.4	−0.004	268.6	0.039	358.5
	Works part-time	−0.010	88.4	−0.022	−121.3	−0.016	−404.1	−0.035	−533.1	−0.016	−223.5
	Works overtime	0.063**	144.0	−0.002	−571.7	−0.075**	−1855.3	0.031	922.6	0.087***	5829.4
Lives in rural area	Lives in urban area	0.078*	159.1	−0.019	211.9	−0.023	−116.9	0.091	263.6	0.067	463.0
	Lives in semi-urban area	0.053	456.3	−0.013	130.7	0.028	−404.3	0.053	−82.6	0.066*	842.6
	AAI	0.046	284.0	0.067***	−10.6	−0.015	1.0	−0.042	−22.5	0.016	−82.3
High climate concern	Low climate concern ↑	0.107***	1031.4	0.137***	1537.4	0.161***	988.4	0.058	1427.1	0.174***	2548.4
	Moderate climate concern ↑	0.063**	204.5	0.080***	378.4	0.037	−180.5	−0.025	−339.9	0.063**	1210.1
	Very high climate concern	−0.020	−151.1	−0.021	−8.0	0.000	388.8	−0.042	28.9	−0.019	52.6
	R square	0.066	0.052	0.095	0.019	0.069	0.023	0.077	0.082	0.108	0.047
	Adjusted R square	0.051	0.039	0.083	0.009	0.046	0.006	0.023	0.043	0.093	0.037
	F-statistic	4.215***	3.952***	8.019***	1.861**	3.054***	1.357	1.425	2.095**	7.325***	4.516***
	Durbin-Watson	1.981	1.935	1.940	1.976	2.084	2.011	1.931	1.766	2.004	1.994

Table 12. Overview of 1.5-degree compatible travel footprint threshold for 2030 (962kgCO2eq (Akenji *et al* 2021) overshoot in the Nordics.

	Iceland	Sweden	Norway	Finland	Denmark
Mean overshoot	3.55	2.58	3.06	3.04	3.04
Meets threshold (N)	380	834	483	665	159
Meets threshold (%)	24.50%	42.10%	36.40%	31.90%	30.90%
Does not emit locally (N)	98	151	86	135	35
Does not emit locally (%)	6.30%	7.60%	6.50%	6.50%	6.80%

from working overtime (likely highly inflated result), low climate concern and being under 25, and the largest negative effect was from low income level.

3.3. Climate-sustainable travel threshold

According to Akenji *et al* (2021), the climate-sustainable travel footprint threshold for 1.5-degree warming targets is 0.962 tCO2eq/cap/year in the Nordic context (based on Finland). Based on our results, all five Nordic countries exceed the 1.5-degree compatible threshold level manifold. Current travel emission levels in the Nordics also exceed the total personal footprint threshold for 2030–2.5 tCO2eq/cap/year (Akenji *et al* 2021) - by just their travel footprint alone (except Sweden at 2.48tCO2eq for travel).

In Iceland, 24.5% of the sample currently meets this threshold, followed by 30.9% in Denmark, 31.9% in Finland, 36.4% in Norway and 42.1% in Sweden (table 12). The underlying factors describing people who meet this threshold vary between the Nordic countries, although some overarching patterns emerged. Low income levels increased the likelihood of belonging to this group in Iceland, Finland and Sweden, while younger age (below 35) reduced the likelihood. Living alone (single adult household) reduced the likelihood of meeting the threshold in Iceland, Norway and Sweden. Low climate concern also reduced the likelihood in Finland, Norway and Sweden. (table 13).

The highest overshoot is in Iceland, exceeding the threshold 3.55 times. Finland, Norway, Denmark and Sweden exceed the threshold between 2.58–3.06 times. When examining factors that significantly contribute to the overshoot, across all countries, a clear pattern emerged. Namely, people who have low climate concern have notably higher overshoot in all Nordic countries at significant levels. On the other hand, high climate concern indicated reduced overshoot only in Iceland and Sweden (table 13), highlighting other reasons for lower mobility and emission levels. In addition, single adult households had higher overshoots in Iceland, Denmark and Sweden, while high income was associated with higher overshoot levels in Iceland, Finland, and Denmark.

4. Discussion

The study set out to examine the travel-related personal carbon footprints in the Nordic countries in relation to socio-demographic background, degree of urbanisation and climate concern. As an additional element, the study assessed the carbon footprints compared to a recommended travel footprint threshold for 2030 and how much the current overshoot is. Emission levels and overshoot were analysed using multiple linear regression, and participation in long-distance travel emissions and meeting the 1.5-degree warming target level were analysed using binomial logistic regression. The following section will discuss the findings and their connection to previous studies.

As expected, car use makes up the bulk of local travel emissions, while public transit use covers up to a third of local travel emissions. Younger age, male gender and living alone in a single-adult household were indicators of higher local travel emissions. Lower local emissions were linked to low-income levels and living in a more densely populated area. Higher income was significantly positively associated with emissions only in Finland, as found in a previous study in the same country (Árnadóttir *et al* 2019). However, patterns varied among other Nordic countries. Overarchingly, low climate concern was associated with higher emissions from local travel, and vice versa.

Our samples' leisure travel participation level is similar to those previously reported by Eurostat (2023). Engagement in leisure travel among our sample is higher than the European average (Eurostat 2023), with the majority of emissions coming from shorter-distance trips, which are likely domestic. Most long-distance round trips in our sample were under 1000 km, predominantly domestic and matching previous reports from the year 2022 (Eurostat 2023). The pattern can also partially be explained by the aftermath of the COVID-19 pandemic, during which our survey sample was collected. It is likely that during this period, people travelled more domestically than internationally and thus the share of short-haul trips in travel distances was higher than in other years. Air travel, although accounting for a smaller portion of leisure trips, makes up the bulk of long-

Table 13. Regression models examining the 2030 threshold level. Model 3a: Binomial logistic regression for predicting who meets the 1.5-degree compatible travel footprint threshold for 2030 at 962kgCO2eq (based on Akenji *et al* 2021). Variables that are significant in the same direction 3 or more times across countries are marked in bold, with the arrow direction indicating the effect on the emissions. Model 3b: Multiple linear regression for examining the overshoot of the 1.5-degree compatible travel footprint threshold for 2030. Overarching variables not indicated for model 3b. Significance levels: $p < 0.01$ ***, $p < 0.05$ **, $p < 0.1$ *.

		Iceland		Finland		Norway		Denmark		Sweden	
		3a	3b	3a	3b	3a	3b	3a	3b	3a	
		n = 1546	n = 1546	n = 2057	n = 2057	n = 1255	n = 1255	n = 515	n = 514	n = 1949	n = 1949
Reference groups		Exp (B)	B	Exp (B)	B	Exp (B)	B	Exp (B)	B	Exp (B)	B
	(Constant) (B)	0.387***	1.564**	0.285***	2.322**	0.545**	2.129*	0.182***	2.430***	1.502	0.416
Age 65+	**Age under 25 ↓**	0.327***	0.829	0.416***	1.137	0.574	3.206**	0.945	0.756	0.356***	2.733**
	Age 26–35	0.589**	0.445	1.037	−0.390	0.917	0.836	2.035*	0.376	0.632**	0.339
	Age 36–45	0.691	0.294	0.984	−0.328	1.226	−0.985	2.317**	0.098	0.786	0.037
	Age 46–55	0.572**	0.143	1.176	−0.545	0.998	−0.113	2.161*	0.436	0.806	−0.374
	Age 56–65	0.687	1.046**	1.253	0.362	0.904	0.073	1.739	−0.007	0.865	0.542
Medium education level	Low education level	1.215	−0.140	1.379**	−0.251	1.250	−0.259	1.537	−1.036**	1.074	0.234
	High education level	1.169	0.075	1.068	0.719	0.976	0.998*	0.741	−0.100	0.826	0.475
Medium income level	**Low income level ↑**	1.885***	−0.367	1.314**	−0.307	0.913	0.093	1.159	0.029	1.288*	−0.998**
	High income level	0.987	0.534*	0.680***	0.770*	1.081	0.663	0.656	1.164***	0.847	0.714
Female + genderqueer	Male	1.198	0.251	1.073	0.377	1.062	0.887*	0.644*	0.413	0.990	0.030
Household with children	**Single adult household ↑**	0.606**	1.350***	0.916	0.603	0.539***	0.286	1.335	1.092**	0.510***	1.059**
	Multi-adult household	0.978	0.450	0.837	0.477	0.866	−0.756	1.155	0.170	0.519***	0.911*
Full-time (35–45 h)	Not working/studying	0.834	0.429	2.250***	−1.181**	1.274	−0.352	1.963**	0.060	1.139	0.266
	Works part-time	1.526	−0.039	1.143	−0.213	1.106	−0.218	0.935	−0.342	1.000	−0.152
	Works overtime	0.542**	0.748*	1.865**	−0.645	2.267**	−1.871	0.896	1.160	0.808	7.690***
Lives in rural area	Lives in urban area	1.564**	−0.369	1.227	0.361	0.985	0.074	1.060	−0.097	1.426**	−0.020
	Lives in semi-urban area	1.121	0.164	1.219	0.094	0.962	−0.357	0.891	0.036	1.273*	0.627
	AAI	0.816**	0.415***	0.976	−0.088	1.055	−0.066	1.069	−0.100	0.947**	−0.085
High climate concern	**Low climate concern ↓**	0.649**	2.120***	0.566***	2.609***	0.610***	2.052***	0.490	2.599***	0.605***	3.635***
	Moderate climate concern	0.903	0.588**	0.794	0.619	1.217	−0.141	0.868	0.099	0.870	1.475***
	Very high climate concern	1.398*	−0.333	1.190	−0.122	1.272	0.209	1.109	0.130	1.083	0.085
	Nagelkerke R square	0.068		0.102		0.047		0.102		0.050	
	R square		0.076		0.035		0.028		0.110		0.064
	Adjusted R square		0.063		0.026		0.012		0.072		0.054
	Chi-square	1.959		4.053		6.831		9.840		4.697	
	Omnibus test	72.458***		155.025***		43.404***		38.661**		74.351***	
	% predicted correctly	75.90%		69.70%		64.00%		71.60%		60.20%	
	F-statistic		5.975***		3.567***		1.719**		2.892***		6.245***
	Durbin-Watson		1.951		1.98		2.015		1.759		1.995

distance travel emissions. Similar findings have been reported before (i.e., Eurostat 2023). However, in our study, car travel made up the bulk of the leisure travel emissions in Finland.

Our study found that a low education level was associated with a reduced likelihood of participating in long-distance travel in three countries, while a high education level was linked with a higher likelihood in two countries. The result is supported by previous studies where the latter effect was noted (i.e., Czepkiewicz *et al* 2019). In terms of emissions, however, higher education was linked to higher emissions only in Norway. Previous research has noted this same association (i.e., Árnadóttir *et al* 2019). However, the direction of the emissions trend varied between the countries, and no overarching observations could be made.

Previous studies have found that Nordic people travel a lot for leisure regardless of income (Sovacool *et al* 2018, Czepkiewicz *et al* 2019). Our study found some differences between the Nordic countries regarding income. Long-distance travel footprint for low-income people in Sweden was noticeably lower than in other countries. Generally, low and medium-income groups emitted less in this category than high-income groups. Also, low income was linked to a lower likelihood of participation and vice versa in all countries except Norway. Prior studies have noted similar findings (Brand and Preston 2010, Árnadóttir *et al* 2019). We hypothesise that part of these differing patterns reflects the COVID-19 pandemic, during which low and medium-income people were impacted more (Sigurjónsdóttir *et al* 2021, Greve *et al* 2021, Geranios *et al* 2022).

Previous studies have noted that older residents in the Nordics travel abroad as much as young people (Larsen *et al* 2023). In our study, we recognize differences in these patterns among countries. Namely, younger people in Iceland, Norway, and Denmark are less likely to participate in long-distance leisure travel than people aged 65 and over. Meanwhile, in Finland and Sweden, younger people are more likely to participate than the reference group. However, when travelling, young people, particularly those under 25, are associated with higher emissions compared to people aged 65 and over. A probable explanation is that older people might take shorter distance trips, while young people travel to faraway destinations.

While spatial differences were expected to emerge (Ottelin *et al* 2019), there were different patterns in the emissions levels in each country. In previous studies, living in urban areas and higher population density are associated with lower local but higher total travel emissions (i.e. Brand and Preston 2010, Ottelin *et al* 2014, Reichert *et al* 2016, Große *et al* 2018). We note similar findings between local emissions and urban areas and higher population density in Iceland, Denmark and Sweden. For long-distance travel emissions, in Finland and Norway, urban dwellers emitted the least, and the opposite pattern emerged in Iceland, Denmark and Sweden. Previously, higher long-distance travel emissions have been connected to living in urban areas (Reichert *et al* 2016, Czepkiewicz *et al* 2018, Ottelin *et al* 2019, Árnadóttir *et al* 2019, Czepkiewicz *et al* 2019, 2020a), similar to our results from Iceland, Denmark and Sweden. We note varying patterns when comparing countries. One possible explanation for the differing results could be that the variable for the degree of urbanisation neglects the differences between dense urban centres and suburban areas located within the same municipalities classified uniformly as urban.

Our study also focused more closely on the connections between climate concern and travel, as it has not been covered much in prior studies. Similarly to prior studies (Alcock *et al* 2017, Árnadóttir *et al* 2019, Czepkiewicz *et al* 2019, Árnadóttir *et al* 2021), people with low climate concern were less likely to participate in long-distance travel in Finland, Norway, and Sweden than those with high levels of concern. In Denmark, people with a very high concern were less likely to travel long-distance.

We also found negative associations between climate concern and local and long-distance travel emissions among the Nordic countries. The relationship with local travel was similar to prior studies where low concern was linked to higher emissions (i.e., Alcock *et al* 2017, Árnadóttir *et al* 2019). The negative relationship between long-distance leisure travel emissions and climate concern reported in this paper differs from most previous similar studies, where the relationship was positive or none (e.g., Alcock *et al* 2017, Czepkiewicz *et al* 2019, Árnadóttir *et al* 2019). More recently, Aasen *et al* (2022) reported a weak indirect negative relationship between climate concern and flying from Norway to Europe for leisure. Furthermore, qualitative studies illustrate how internalised knowledge of the impacts of climate change and related emotions motivate those who reduce flying for the sake of climate (Jacobson *et al* 2020, Wormbs and Wolrath Söderberg, 2021). The qualitative studies suggest that extreme levels of climate concern should predict reduced emissions from long-distance travel. In our study, there is no significant difference in long-distance travel emissions between high and extreme levels of concern. The most pronounced difference is between people with exceptionally low levels of concern and those with higher concerns.

The gap between environmental attitudes and flying has been explained in various ways, including an underestimation of aviation's environmental impact by flyers and the value of flying outweighing the environmental concern (Higham *et al* 2014, Cocolas *et al* 2021). Schmidt *et al* (2023) highlight how people use various strategies to resolve the cognitive dissonance between climate concerns and flying. One such strategy might be adjusting the concern levels rather than travel patterns, which might be another way to explain our results regarding the lowest-concern group.

Our results indicate that the 'flight shame' trend may have sufficiently changed norms around flying in the Nordic countries to be reflected in travel emission patterns. The relationship between climate concern and emissions is the strongest in Sweden, where the 'flight shame' discourse originated (Becken *et al* 2021, Wormbs and Wolrath Söderberg, 2023). However, our sample does not allow us to study the pathways between climate concern, emotions and social norms associated with flying and travelling on the one side, and the emission reductions on the other side.

The main indicator behind the high overshoot was low climate concern. At the same time, despite living in a relatively wealthy society, belonging to less advantaged socio-demographic groups was connected to meeting the threshold level. This finding somewhat contrasts previous studies (i.e. Sovacool *et al* 2018) where reductions in travel-related emissions have not been associated with income or affordability. But the result could also reflect underlying issues relating to transport poverty, accessibility and the social floor of the sector (e.g. Dillman *et al* 2021b). Are these people choosing this lifestyle, or are they travelling less due to a lack of accessibility or resources? Is their socio-economic background limiting their opportunities, competencies, or resources required for travel? The key lies in providing necessary transport services to enable equal opportunities at an affordable level for residents of all socio-economic groups. It is clear that the Nordic countries are exceeding the environmental ceiling of the transport sector, but it remains unclear whether they are meeting the social floor.

4.1. Policy outlook

Current strategies to curb the impact of climate change are not enough to meet the reduction targets set by the Paris Agreement. Personal transport emissions exceed the recommended thresholds (Akenji *et al* 2021) about 2.5–3.5 times in the Nordic countries, as demonstrated in this study. At the core of transport policies moving forward should be solutions that are environmentally sustainable *yet al*so inclusive of all socio-economic groups. Considering that affluence is a key driver of emissions, a sustainable transition can be reached with a combination of lifestyle changes, technological improvements, and changing of societal, cultural and economic norms that currently support excess consumption (Wiedmann *et al* 2020).

Although single-country approaches to climate change mitigation have been criticised (Greaker *et al* 2019, Salvucci *et al* 2019, Tilsted *et al* 2021), the study highlights the context dependence of the transportation sector in this regard. Upon examining the Nordic countries, which are known to have a similar cultural, social and economic background (Olafsson 2013, Tiemer 2018), noticeable differences in transport-related behaviour emerged between the countries, which could justify a more personalised approach. However, emphasising the large-scale overshoot of the Nordic transport footprints, the current policies are insufficient (Bhowmik 2019) and could benefit from international alignment.

Policies should enable better access to public transportation across all socio-economic groups, including improved train connections. Good accessibility to local public transport can be beneficial to both low- and high-income people so that they are able to meet their needs at low emission levels. An overarching European policy to increase train access within the continent would greatly reduce long-distance travel emissions yet enable people to travel abroad. In addition, taxes on plane tickets due to the high emissions from air travel could help reduce air travel in general.

The results clearly show a connection between low climate concern and high emissions. Policies could support raising climate awareness and concern could be a promising tool to support climate action on a personal level (Cocolas *et al* 2021, Aasen *et al* 2022), although high climate concern and voluntary reductions alone might not be enough to meet the 2030 threshold for travel.

4.2. Limitations and suggestions

As is typical with survey methods, our sample was likely influenced by the distribution method and timeline. The authors considered the risk of bias towards certain demographic groups due to the survey distribution method. Efforts were made to counter this by using targeted advertisements directed at different age groups, as well as providing the survey in both the national language and English in all countries (and Polish in Iceland due to the large Polish community in the country) to engage people with different language backgrounds. Due to its theme, the survey might have appealed more to climate-concerned citizens. We also recognise that the Nordic countries are considered leaders in climate action and that is reflected in the higher-than-average climate concern level of the general population. Therefore, the sample might be skewed towards people with higher awareness and who are already taking some kind of climate action in their lives. On the other hand, the sample includes a sufficient number of answers from people with low and very low levels of climate concern. In addition, the method of distribution via social media marketing, although successful, led to a relatively low participation of young people under 25 and male respondents (see also table 2). To help mitigate the impact of underrepresentation, the socio-demographic background variables were used as controls in the regression setting.

The survey was conducted during the aftermath of the COVID-19 pandemic and respondents were asked to reflect on their travel in a period that overlapped with the transition out of lockdowns. This is likely to have influenced the footprints. It can also be therefore assumed that the travel footprints of the Nordic residents are higher under normal conditions than what is presented in this study. Furthermore, the aim of the survey was not to achieve sample representativeness, but rather to achieve a high number of quality responses to increase the chances of capturing extreme cases. The study therefore provides a snapshot of Nordic mobility, but it cannot be generalised to the whole populations of these countries. A socio-economic comparison of the sample characteristics and the country averages across the included five countries is provided in Heinonen *et al* (2022).

What is more, it is important to note that emissions calculated in this study are estimates, with many emissions factors retrieved from older studies (e.g., Chester and Horvath 2009). Although emissions factors have not changed much throughout the years (e.g., Bieker 2021) and thus would not affect the results by much, the comparison with the recommended threshold level should be considered with care. The comparison should be taken as a broader indication of the current state of travel emissions in the Nordics, with some overarching implications for policy directions, but not as absolute truth. Future studies could take the analysis further by using more comprehensive estimates or conducting a sensitivity analysis of the estimates.

In addition, the study does not consider the impact of consumption at travel destinations, which is known to increase travel-related emissions (Sharp *et al* 2016, Ottelin *et al* 2019). It would also be interesting to identify traveller types in the Nordics, distinguishing between high and low emitters on local and long-distance levels (i.e. Mattioli *et al* 2023).

Even though our study suggests an influence of climate concern and changing norms around travel on emissions, it does not specifically study pathways between norms, attitudes, emotions and reducing intentions or behaviour. It does not allow us to interpret the relationships or pathways leading to emission reductions in detail. Future studies should include more detailed measurements of norms and analyse them with structural equation modelling. Furthermore, the study is cross-sectional and only provides a snapshot of a certain moment in time. Therefore, it does not allow us to make conclusions about the influence of *changing* levels of concern or norms on travel reduction.

In addition, the degree of urbanization variable used here is crude and further disaggregation would be useful in the future. A more detailed look at the spatial distribution of footprints could support targeted regional and local level policies.

Lastly, the threshold was chosen based on the Finland context example in Akenji *et al* (2021), where a percentage reduction in total footprint to meet the 2030 threshold was directly applied to the travel footprint domain. A more customised threshold within each country could change the threshold results due to differences in ratios between domains. In addition, a more personalised approach to setting thresholds could account for differences in energy mix, state of infrastructure such as electric charging stations or public transportation, and travel distances to major destinations. For example, Iceland being an island and Finland being less connected to the rest of Europe will affect people's choices in travel. Travel mode choice and distances in leisure travel are therefore somewhat guided by the geographical limitations of the countries. Furthermore, our data included all the main alternative power sources for private vehicles, but in the future studies the impact of owning such a vehicle should be studied.

Although there are people today who meet this 2030 threshold level, we see indications that some of these people might belong to less advantaged socio-economic groups. Although the Nordics are considered to excel in social welfare and to be leaders in environmental sustainability, the countries must be mindful of potential inequities in access to transportation. Future studies should consider the questions of travel poverty and travel equity in long-distance travel. Potential avenues include exploring the questions of social minima and poverty thresholds in long-distance travel.

5. Conclusion

The study aimed to provide analyses of personal travel footprints across the Nordic countries, and the relationship of the footprints with climate change concern. Furthermore, the study contributed to literature by comparing the personal travel footprints to recommended levels that are needed to stay within the 1.5 °C warming limit.

Based on the analysis, it was evident that, on average, people living in the Nordic countries exceed recommended threshold levels for personal travel manifold. Long-distance travel was the main contributor to the total personal travel footprint, as also evidenced in prior literature. Within this study, low climate concern, age under 25, and single adult households were associated with higher local and long-distance travel footprints. Total personal travel footprints, on average, in all five Nordic countries exceeded the recommended threshold level of 0.7tCO2eq by 2030. When examining those who meet the threshold today, the study revealed indications of those people potentially belonging to lower socio-economic groups.

Considering the critiques towards the sufficiency of Nordic transport policies in climate mitigation and the results of this study, it is clear that personal transport emissions in the Nordics need to rapidly reduce to stay within the 1.5 °C global warming limits. Furthermore, local context (such as energy mix, socio-demographic composition of society, urban-rural divide, etc) is key in travel-related policymaking, even among countries with similar cultural and economic backgrounds. However, it is important to support disadvantaged groups of society within the sustainable transport transition. The transition should make sure that the basic travel needs of all groups of society are met (or, the social floor) at an affordable level, while limiting excess air travel of more privileged socio-economic groups to stay below the environmental ceiling.

Acknowledgments

The authors thank the Icelandic Centre for Research (Rannís), grant number 207195-053, Háskólasjóður Eimskipafélags Íslands/The Eimskip University Fund of the University of Iceland, and Husnæðis- og mannvirkjastofnun (HMS) for funding the study.

Data availability statement

The data that support the findings of this study are openly available at the following URL/DOI: https://doi.org/ https://zenodo.org/records/10656970. Data will be available from 31 March 2024.

Appendix

Table A1. Statistical overview of climate concern variable.

	Climate concern				N in climate concern groups			
Country	Average	25th percentile	Median	75th percentile	Low	Moderate	High	Very high
Denmark	3.98	3.60	4.20	4.60	32	62	290	131
Finland	3.64	3.00	4.00	4.40	353	359	883	489
Iceland	3.58	3.00	3.80	4.20	223	366	730	234
Norway	3.35	2.80	3.60	4.20	263	327	586	150
Sweden	3.80	3.40	4.20	4.60	238	280	923	541
All	3.64	3.20	4.00	4.40	1109	1394	3412	1545

Table A2. Statistical overview of total, local and long-distance travel footprints.

		N	No. of zeroes	Mean	STDV	25th percentile	Median	75th percentile	Kurtosis	Skewness
Iceland	Total travel FP	1553	24	3417	4349	989	2153	4499	103.47	7.28
	Long-distance travel FP		282	2159	3650	160	1120	2661	15.32	3.26
	Local travel FP		98	1257	1801	176	656	1514	60.50	5.45
Finland	Total travel FP	2084	52	2928	7848	736	1706	3405	1018.58	28.40
	Long-distance travel FP		440	1728	7194	114	649	1819	1137.86	30.76
	Local travel FP		135	1201	1668	250	656	1474	25.76	3.99
Norway	Total travel FP	1326	32	2941	8104	499	1559	3207	381.46	16.85
	Long-distance travel FP		387	1770	7361	0	450	1739	449.42	18.88
	Local travel FP		83	1171	1945	125	543	1475	45.52	5.26
Denmark	Total travel FP	515	17	2925	3353	747	1906	3966	14.92	2.97
	Long-distance travel FP		135	1821	2861	0	845	2316	26.55	3.92
	Local travel FP		35	1104	1476	195	581	1493	11.74	2.93
Sweden	Total travel FP	1982	63	2482	7455	468	1248	2685	265.66	14.85
	Long-distance travel FP		674	1391	6826	0	259	1134	313.33	16.28
	Local travel FP		152	1091	1692	187	562	1287	35.01	4.74

Table A3. Total travel footprint mean, median and standard deviation for climate concern, income level and degree of urbanisation.

	ICELAND			FINLAND			NORWAY			DENMARK			SWEDEN		
	Mean	Median	STDV	Mean	Median	STDV	Mean	Median	STDV	Mean	Median	STDV	Mean	Median	STDV
Low climate concern	5148	2907	6462	5207	2625	17818	4670	2113	8155	5647	3895	5384	5826	1869	16840
Moderate climate concern	3575	2453	3839	2857	1749	3849	2364	1394	2751	2787	1910	2687	3197	1233	10918
High climate concern	3026	1970	4004	2415	1603	2617	2508	1539	9250	2684	1841	2717	1789	1188	2038
Very high climate concern	2739	1724	3019	2262	1483	2449	2859	1211	10384	2859	1833	3973	1825	1199	2079
Low income level	2738	1722	3056	2372	1356	5197	2850	1572	7857	2427	1530	2688	1793	1043	2252
Medium income level	3349	2230	3608	2766	1687	3714	2636	1497	4027	2521	1872	3311	2545	1211	9000
High income level	4134	2476	5670	3897	2466	12525	3168	1575	10331	3875	2582	3898	2850	1408	8494
Lives in urban area	3379	2089	4332	3191	1636	11325	3222	1586	10576	2797	1775	3447	1973	1248	2440
Lives in semi-urban area	3860	2368	5648	2800	1676	3484	2545	1552	3894	3091	1943	3472	2989	1211	10478
Lives in rural area	3267	2360	3240	2645	1799	3269	2879	1522	7417	2975	1997	3035	2525	1343	7118

Table A4. Local travel footprint mean, median and standard deviation for climate concern, income level and degree of urbanisation.

	ICELAND			FINLAND			NORWAY			DENMARK			SWEDEN		
	Mean	Median	STDV	Mean	Median	STDV	Mean	Median	STDV	Mean	Median	STDV	Mean	Median	STDV
Low climate concern	2232	1093	2861	2107	1369	2670	2116	1144	3251	2413	1677	2647	2001	939	3085
Moderate climate concern	1439	938	1964	1230	679	1546	1038	522	1420	1501	716	1747	1131	624	1588
High climate concern	990	566	1267	1000	580	1284	924	493	1384	930	527	1283	916	530	1228
Very high climate concern	876	510	1186	888	562	1110	773	379	1046	983	562	1128	967	499	1418
Low-income level	1131	623	1541	992	562	1432	1026	458	1619	814	383	1074	988	496	1507
Medium income level	1358	756	1927	1216	657	1572	1241	568	2018	971	586	1137	975	562	1316
High income level	1299	625	1923	1491	859	2002	1209	593	2074	1573	812	1967	1206	625	1930
Lives in urban area	1147	593	1675	1305	675	1968	1298	564	2310	758	374	1019	882	470	1328
Lives in semi-urban area	1422	845	1758	1121	624	1402	1126	572	1565	1440	807	1678	1146	606	1782
Lives in rural area	1613	881	2252	1123	646	1390	1063	526	1794	1373	812	1793	1377	763	2042

Table A5. Long-distance travel footprint mean, median and standard deviation for climate concern, income level and degree of urbanisation.

	ICELAND			FINLAND			NORWAY			DENMARK			SWEDEN		
	Mean	Median	Standard Deviation	Mean	Median	Standard Deviation	Mean	Median	Standard Deviation	Mean	Median	Standard Deviation	Mean	Median	Standard Deviation
Low climate concern	2915	1508	4925	3100	603	16585	2555	301	6316	3234	1330	4451	3825	93	15167
Moderate climate concern	2135	1045	3025	1627	664	3211	1326	405	2154	1286	642	1917	2066	260	10758
High climate concern	2035	1120	3717	1416	649	2224	1584	514	8679	1754	1003	2189	872	287	1581
Very high climate concern	1863	942	2720	1374	660	2088	2086	486	10199	1876	640	3825	857	289	1526
Low income level	1607	704	2429	1379	455	4665	1823	525	7371	1613	702	2430	804	161	1602
Medium income level	1992	1120	2760	1551	600	3077	1396	352	3272	1550	739	3108	1570	241	8818
High income level	2835	1448	4947	2406	1054	11651	1960	470	9386	2302	1120	3083	1644	341	7535
Lives in urban area	2232	1124	3695	1886	603	10466	1924	363	9438	2039	1037	3195	1091	393	1957
Lives in semi-urban area	2438	1120	4729	1679	668	2941	1418	467	3467	1651	797	2604	1843	177	9870
Lives in rural area	1654	776	2316	1522	711	2836	1815	491	7071	1602	583	2435	1147	172	5944

Declaration of interest statement

The authors declare no conflicts of interest.

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