



Health in mobility planning: An assessment of how health is considered in Sustainable Urban Mobility Plans

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ABSTRACT

Introduction: Urban mobility can detrimentally impact city dwellers' health and quality of life, e.g. through air pollution, noise and traffic injuries, but offers opportunities for health promotion, e.g., through active travel. While the health impacts of transport are well known, the extent to which health is considered in mobility plans is less obvious. The European Commission encourages cities to develop Sustainable Urban Mobility Plans (SUMP) to improve residents' quality of life. We assess how health is addressed in SUMP by examining: i) key health and health equity terminology, ii) explicit transport pathways to health, iii) health targets and key performance indicators, and iv) the health-rationale of actions and measures.

Methods: Using a customised health dictionary, we perform a quantitative text analysis of SUMP issued from 2006 to 2023 (n = 230) from 31 European countries listed on the European Local Transport Information Service (Eltis) City Database. We further validate this by an in-depth qualitative analysis of a purposive sub-sample (n = 13).

Results: The findings show that while the prominence of health in SUMP seems to be increasing, the link between transport and equity, and social and mental wellbeing is not frequently discussed. Detailed targets and KPIs for several health pathways are scarce or missing, as are the health rationale and health outcomes for proposed measures. Overwhelmingly SUMP's health aspirations focus on minimising detrimental health impacts of transport, primarily from traffic injuries and to a lesser extent from air pollution. Health related concepts such as accessibility and active travel feature prominently but are not explicitly identified as an opportunity to enhance health.

Conclusion: Urban mobility planning across Europe seems to miss an opportunity to embrace mobility as a driver of health promotion.

1. Introduction

Health has implications for physical, mental and social wellbeing (World Health Organisation, 1946) and is a state where not only

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the needs of vulnerable individuals are met, but where current and future health is protected and promoted, and health inequalities are reduced (Davis et al., 2019). Transport can influence health both positively and negatively through various detrimental and beneficial pathways such as road traffic injuries, air and noise pollution, and access to opportunities including public and green space for various users. Transport policies that promote health can have major environmental and economic co-benefits and are critical for achieving the United Nations Sustainable Development Goals (SDG) presented in the 2030 Agenda for Sustainable Development (UN, 2015).

The links between transport and health and wider co-benefits are recognised in transport policy. For example, the member states of the WHO European Region adopted a declaration in 2023 which included a commitment to promote healthy, safe, climate-friendly and inclusive mobility and transport for all (World Health Organization, 2023). This is to be achieved by developing and implementing policies to promote health, safety, climate-friendliness and active mobility, by creating favourable conditions, and by planning safe infrastructures for walking and cycling suitable for all populations.

The concept of SUMP can be traced back to the EU's 2005 Thematic Strategy on the Urban Environment, which recommended the development of guidelines for Sustainable Urban Transport Plans. This concept was further expanded in the EU's 2009 'Action Plan on Urban Mobility' and given a comprehensive definition and guidelines in the 2013 'Urban Mobility Package'. Sustainable Urban Mobility Planning is an integrated and strategic approach with the aim of supporting transitions towards sustainable mobility and enhancing quality of life of residents. It is a vision-led, fact-based and resilient approach designed to address the urban mobility challenges of the people and businesses in the entire functional urban area. It advocates a thorough assessment of the status quo and future trends, a shared vision that is operationalised into strategic objectives, and an integrated set of measures whose implementation should be systematically monitored (Rupprecht Consult, 2019). The European Commission has been advocating the widespread uptake of SUMP as a cornerstone of European urban mobility policy.

The relationship between SUMP and health is recognised in a dedicated guide "Linking transport and health in SUMP: how health supports SUMP" (Davis et al., 2019) within a revised edition of SUMP guidelines (Rupprecht Consult, 2019). Here, a call is made for SUMP to explicitly outline transport's pathways to health and include health promotion as an objective (Davis et al., 2019). Recent studies also emphasise that the link to health should be included as a standard in mobility frameworks and that appropriate indicators and methods of assessment should be used to assess the progress of SUMP towards health targets (Giles-Corti et al., 2022a; Lozzi and Monachino, 2021; Okraszewska et al., 2022).

Transport affects health through interlinked pathways as has been recognised in several studies of transport and health (e.g. Glazener et al., 2021; Hannah et al., 1991; Khreis et al., 2017; van Wee and Ettema, 2016; Widener and Hatzopoulou, 2016). According to Glazener et al. (2021), "transport" is the synergistic outcome of the interplay between four factors: i) land use and the built environment, ii) transport infrastructure, iii) transport mode choice, and iv) transport technologies and disruptors. Transport influences environmental exposures and lifestyles, or pathways to health by influencing factors which are beneficial to health (e.g. green spaces, physical activity and access) and detrimental to health (e.g. air pollution, noise and social exclusion). Annex 1 shows a conceptual model of transport-health pathways, their definitions and health outcomes based on Glazener et al. (2021).

Attention to health impacts of transport and the evidence to support it have been increasing in the past decades. In addition to the well-known health pathways of transport like air pollution and road traffic injuries, other pathways such as physical activity have been identified since 1990s, as exemplified by the publication of *Health on the Move* (Transport and Health Study Group, 1991). Reviews on other health impacts of transport have expanded from some systematic and scoping reviews in the 1990s and 2000s to an increasing number of systematic reviews in the 2010s and the 2020s (for review compilations see Mindell et al., 2011; Mindell and Watkins, 2024; World Health Organisation, 2011). Targeted reviews of the impacts of specific transport interventions or policies have included those related to active travel (Cavill et al., 2008; de Nazelle et al., 2011; Roaf et al., 2024), public transport investments (Anciaes and Alhassan, 2024), speed limits (van Erpecum et al., 2024), and psychological (or 'soft') measures that make use of information dissemination and persuasion techniques (Chatterjee and Carey, 2018; Larsen et al., 2024). How these impacts vary by socio-economic group or ethnicity has also been increasingly investigated (see e.g. Hosking et al., 2024). In recent years, the recognised effects of transports have been expanded to include subjects like the psychological impacts (Conceição et al., 2023; Foster et al., 2024; Williams et al., 2024), gender differences (Sagaris et al., 2024), and the potential health implications of new transport modes like electric micro-mobility (Bretones et al., 2023) and autonomous vehicles (Crayton and Meier, 2017). Mirroring this ever-growing evidence base, transport-health frameworks have also been expanded and become more holistic. Over time, recognised pathways such as access, physical activity, air quality, safety, and noise (Dannenberg and Sener, 2015; Lyons et al., 2014) have been expanded to include green space exposure, heat, community severance, social exclusion, climate change (Khreis et al., 2016), mobility independence, stress, roadway contamination and electromagnetic fields (Glazener et al., 2021).

To date, few studies have empirically examined the degree to which health and equity goals and pathways have been incorporated into urban mobility plans. Arsenio et al. (2016) analysed 40 pilot cities in Portugal and found that the first generation of SUMP made modest contribution to addressing equity in accessibility. Mozos-Blanco et al. (2018) found that there was a large variability in both the quality of initiatives to improve active mobility and in their implementation across 38 Spanish SUMP. Cirianni et al. (2018) proposed a method to examine and benchmark SUMP regarding cycling and pedestrian mobility objectives and actions and applied it to six cities across Europe. They concluded that European cities are striving to enhance cycling and pedestrian mobility through various material, immaterial and governance actions. Lozzi and Monachino's (2021) investigation of mobility planning across the European, national and local levels in 4 cities concluded on the importance of standardizing the incorporation of health frameworks and metrics. Maltese et al.'s (2021) review of major Italian cities' SUMP highlighted the need for a comprehensive policy package approach to promote active travel. Okraszewska et al.'s (2022) examination SUMP in five cities in 3 European countries concluded on the need to define clear indicators and to collect data to directly identify the impact of SUMP on physical activity.

This article assesses the extent to which health is reflected in SUMP in European cities, in particular with regards to: i) the presence

of key health and health equity terminology, ii) how explicit transport pathways to health are made, and iii) whether health is operationalised into targets and key performance indicators (KPIs) and iv) how well elaborated is the health-rationale of various actions and measures.

To do so, a mixed methods approach was used which combines a wide-ranging quantitative text analysis of 230 SUMP from across 31 European countries and a detailed qualitative analysis of 13 SUMP from a purposive sample that reflects the range of city sizes, countries, and focus on health. This article is divided into four main sections starting with the research methods (Section 2). This is followed by the results of the quantitative text analysis (Section 3) and the qualitative evidence synthesis (Section 4). Section 5 sets out the main conclusions and the discussion.

2. Research methods

A three-stage mixed methods approach was used to review how health is considered in SUMP (Fig. 1). First, a customised *health dictionary* (Annex 2) and a *policy analysis checklist* (Annex 3) was developed in which the key issues of health were identified based on the health themes, keywords and pathways in the conceptual model of Glazener et al. (2021) (Annex 1), and existing SUMP and health reviews outlined in the introduction. The health dictionary keywords were allocated into three separate custom sub-dictionaries for more precise analysis of three overarching concepts: i) health, ii) equity, and iii) health pathways. The keywords were first translated using Google Translate (Google LLC, 2023) then validated by native speakers of all 22 languages except for five (Croatian, Danish, Estonian, Lithuanian, and Norwegian).

Second, using the dictionary, a *quantitative text analysis* examining the terms contained in the health dictionary was carried out on 230 SUMP listed on the European Local Transport Information Service (Eltis) City Database of Sustainable Urban Mobility Plans. Eltis is a platform of the EU Urban Mobility Observatory financed by the European Commission and an important source of urban mobility data and information across Europe. Eltis maintained its City Database in part through relying on its community for keeping it comprehensive and up to date. Data could be submitted by the Eltis community through a form on its website (EU Urban Mobility Observatory, n.d.). When accessed on June 28, 2023, the database contained a list and map of cities in Europe where SUMP had been identified, and the platform allowed for filtering based on if the city had the SUMP available online. The database contained 631 entries of cities with a SUMP available online. Following initial data cleaning with removing blanks/NAs and removing duplicates based on city and country and based on URL (keeping first city in alphabetical order where duplicates existed), 596 unique cities were identified. Duplicate links in the Eltis database typically were where the same plan was listed for multiple cities located in the same urban area. From these 596 cities, it was possible to locate and extract full SUMP document texts for 230 cities across 31 countries (Fig. 2). The publication year of the SUMP in our final dataset ranges from 2006 to 2023. Annex 5 shows SUMP in dataset published per year and by country.

SUMP documents for the remaining cities were unavailable for many reasons. We extracted the SUMP text automatically when a URL in the database led to PDF; when it did not, we performed a manual search for a correct link for the SUMP and then extracted the text where available. About half of the 596 entries had non-responsive links or non-readable PDFs. For several entries, URLs led to pages that no longer existed, and the correct links/SUMP documents were unable to be found in many of these cases. In several other cases, URLs led to pages that described SUMP in general or the city's SUMP preparation process, but an actual SUMP had not yet been developed or published online. In some cases, there were multiple versions of SUMP, in which case we selected the most recent SUMP for analysis. Throughout the data gathering process, we performed checks of multiple random samples to ensure that the text was

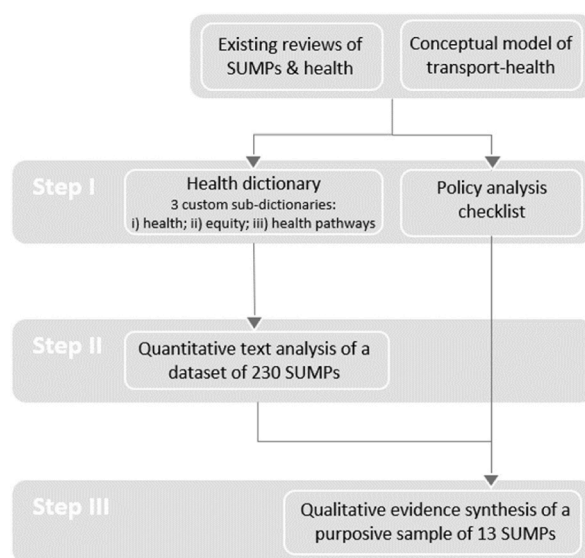


Fig. 1. The three-step approach.

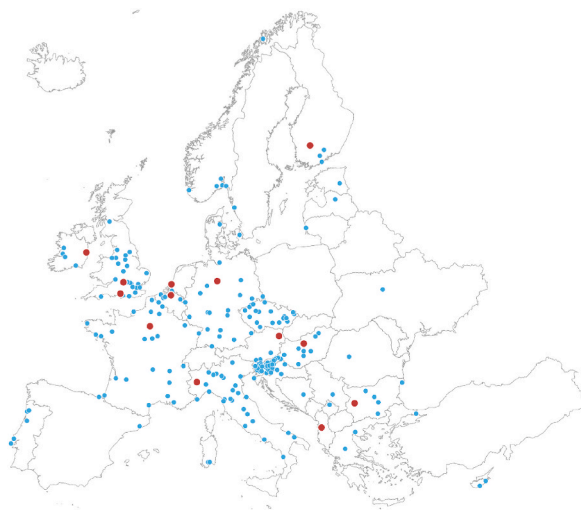


Fig. 2. SUMPs analysed by the quantitative text analysis (blue) and those also included in the purposive sample (red).

extracted correctly and that it was indeed the city's SUMP. Fig. 3 demonstrates the data gathering process that resulted in the final 230 entries in our dataset from the initial 631 entries in the Eltis database.

Using R (R Core Team, 2023), the three sub-dictionaries were employed to determine i) the frequency of words from the dictionary, and ii) "scores" for each of the overarching concepts (health, equity, and health pathways) – the ratio of number of times the keywords are included to the total number of tokens in the SUMP text. This analysis aimed to provide an overall understanding of the extent to which health is mentioned in SUMPs, without necessarily determining which SUMPs are superior in terms of health aspects. Annex 4 elaborates on the quantitative analysis methodology in detail, including software used, limitations, and code.

Third, the findings from the previous step were validated with an in-depth analysis of a purposive sample of 13 SUMPs. This involved a *qualitative evidence synthesis* (Grant and Booth, 2009), a method which uses purposive sampling to link and compare the results of qualitative studies, using the policy analysis checklist.

To select a purposive sample, a quantitative scan of all SUMPs was done based on a simplified 'health score' (i.e., ratio of the number of times "health" was mentioned to the total word count). This indicator was used as a proxy for overall attention to health in each SUMP. After removing documents with no mention of health, the remaining SUMPs were organised into quintiles, representing a set of documents ranging from minimal reference to health to those with most extensive reference to it. The following considerations were taken into account when choosing the final purposive sample of SUMPs (Table 2).

- a wide range of 'health scores' (from low to high);
- a diverse set of countries from which the SUMPs originated;
- a range of city sizes;
- older and newer documents, from the late 2000s to the early 2020s.

3. Results

3.1. Quantitative text analysis

There is a large variety in the length and content of the SUMPs, as well as the number of SUMPs which have been produced in different countries. One reason is that SUMPs are mandatory in certain countries for cities above a certain size (e.g. France and Italy). In some countries, cities need to have drafted a SUMP to be able to access government funding for local transport projects (e.g. Belgium and Slovenia). However, in most others, SUMPs are not mandated or incentivised. The inclusion of the term "health" and its variants (e.g. healthy, unhealthy, healthier) in SUMPs is shown to have been on a slight upward trend in the past 20 years (Fig. 4). This upwards trend is also present in the normalised health scores (not shown).

The application of the three sub-dictionaries reveals low overall average scores, with health (as estimated by dictionary-based scores) garnering more attention than equity, followed by health pathways (Fig. 5).

The *relative focus* on the three health-related concepts (health, equity, and pathways to health) varies across the different countries in the dataset (Fig. 6).¹ SUMPs in eight countries place more emphasis on health compared to equity or pathways, with two countries

¹ The number of SUMPs in each country should be taken into consideration, as those with fewer SUMPs should not necessarily be considered representative of the language overall, while those with higher numbers might be considered more representative.

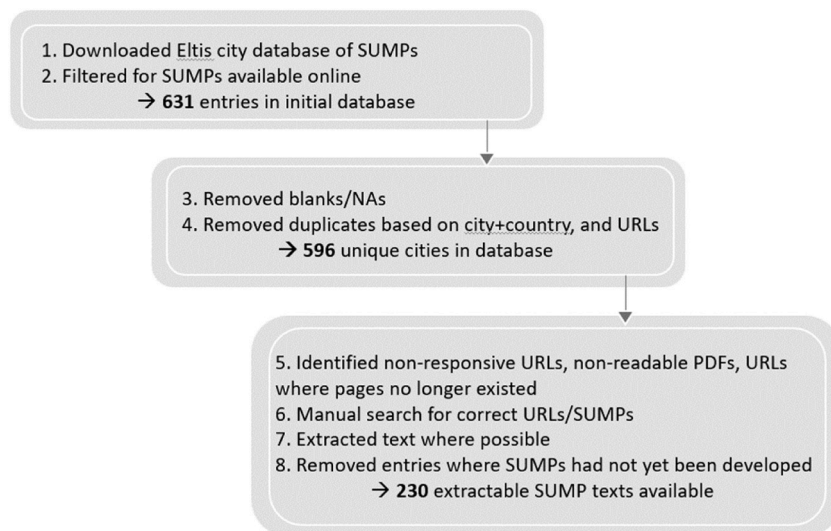


Fig. 3. Data gathering process for the quantitative sample.

Table 1

Top 10 terms in SUMP from the health, equity and pathways sub-dictionaries, combined from all languages.

Top words from health sub-dictionary	Frequency	Top words from equity sub-dictionary	Frequency	Top words from pathways sub-dictionary	Frequency
secur*/safe*	2933	access*	4371	bicycl*/bik*/cycl*	4556
health*	2419	cost*/expens*	1504	walk*/pedestrian*	2628
activ*	889	inclusiv*	1393	speed	1148
risk*	841	social*	1190	noise/loud	975
fit*/sport*/exercise	456	employ*/job*/work*	633	green	855
accident*/crash*/collision*	365	afford*	300	greenhouse gas*/emission*	829
dead*/death/kill*/mortality/fatal/casualt*	238	equal*/equit*	269	clean	286
care	211	community	147	pollut*/air quality/smog	206
injur*	128	disabilit*/disable*/handicap*	125	congestion/traffic jam*	126
quality of life/liveability	98	fair*/justice	57	renewable	41

(Spain and Italy) placing significantly more emphasis on health. Only one country (Romania) has more emphasis on equity present in its SUMP, while four countries have more relative emphasis on pathways in their SUMP (Denmark, the Netherlands, Cyprus, and France).

Terms related to *cycling* (from the pathways sub-dictionary) and *access/accessibility* (from the equity sub-dictionary) appear to be the most important (Table 1), followed by terms related to *safety/security*, and *walking/pedestrians*. For the equity sub-dictionary, terms relating to access and accessibility are frequently mentioned, followed by terms related to cost, inclusivity, social aspects, jobs, affordability, equality/equity, community, and disability. Among key terms for health pathways, biking/cycling are the most mentioned by far, followed by terms relating to walking/pedestrians, speed, noise, emissions, pollution and congestion.

3.2. Qualitative synthesis

The 13 cities sampled for in-depth qualitative synthesis cover a wide range of health scores (0.02–0.65), city sizes (100K–6,715K) and SUMP publication years (2008–2022) (Table 2).

3.2.1. SUMP's health characteristics

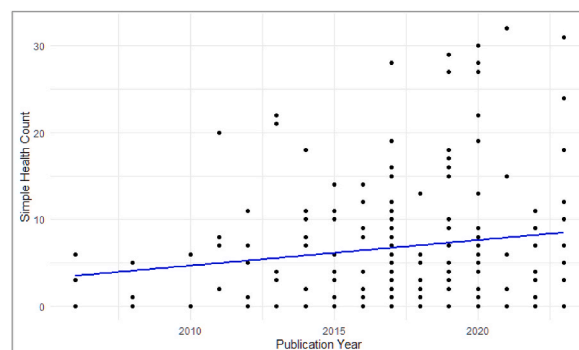
Health, well-being and quality of life are mentioned to various degrees in the 13 selected SUMP, especially in more recent documents. All documents include some analysis of the mobility situation and mobility trends, while health-related status-quo and trends are often not described. Most documents mention the adjective healthy, which is usually combined with “city” (and its different forms such as healthy urban/living environment). Healthy streets (or place), healthy mobility, and healthy lifestyles (or living, behaviour) are also mentioned, but to a lesser extent. When health is discussed, the focus is on physical health while social and mental wellbeing receive much less attention. Many SUMP touch on equity or inclusivity in terms of ease of access to opportunities and/or ease of movement for vulnerable groups, but very few (e.g. Oxfordshire and Southampton) elaborate on the fact that transport and its related policies could have unequally distributed health impacts across space and society which needs to be addressed.

Table 2

Overview of sample cities and SUMPS in purposive sample for qualitative analyses.

#	Location	Inhabitants urban centre ^a	Name	Year	Simple count of “health” ^b	Normalised health score ^c	Normalised equity score ^c	Normalised health pathways score ^c
1	Antwerp (Belgium)	490K	Active and accessible Antwerp; Mobility plan 2020, 2025, 2030	2015	8	0.19	0.13	0.20
2	Budapest (Hungary)	1,736K	Budapest Mobility Plan 2030	2019	13	0.59	0.34	0.07
3	Delft (the Netherlands)	100K	Mobility program Delft 2040; Our Delft, sustainably accessible	2020	1	0.19	0.09	0.55
4	Dublin (Ireland)	1,260K	Transport Strategy for the Greater Dublin Area 2016–2035	2016	12	0.19	0.16	0.13
5	Hannover (Germany)	520K	Mobility Master Plan 2025	2011	7	0.09	0.11	0.09
6	Île-de-France (France)	6,715K	Urban travel plan	2014	49	0.02	0.03	0.14
7	Oxfordshire (UK)	152k	Local Transport and Connectivity Plan 2022–2050	2022	234	0.63	0.35	0.20
8	Sofia (Bulgaria)	1,170K	Mobile Sofia 2035; Sustainable mobility for everyone	2019	15	0.13	0.15	0.08
9	Southampton (UK)	250K	Connected Southampton Transport Strategy 2040	2019	113	0.52	0.51	0.23
10	Tampere (Finland)	200K	Sustainable Urban Mobility Plan	2021	15	0.65	0.27	0.25
11	Tirana (Albania)	418K	Sustainable Urban Mobility Plan for the City of TIRANA	2020	22	0.23	0.30	0.17
12	Turin (Italy)	872K	Urban plan of sustainable mobility	2008	5	0.03	0.00	0.00
13	Vienna (Austria)	1,867K	STEP 2025 Thematic concept; Urban Mobility Plan Vienna; Together on the move	2015	4	0.34	0.16	0.17

Notes.

^a From Eltis City database.^b Including its variants (e.g. healthy, unhealthy, healthier).^c The ratio of the number of times the term and its associated keywords were mentioned to the total token count, normalised to a range between 0 and 1 using min-max normalisation. See Annex 4 for methods details.**Fig. 4.** Timeline of simple health count (the mentions of “health” and its variants), in SUMPs in dataset, outliers removed.

Many SUMPs argue the urgency of addressing health pathways, often underscoring their commitment to reduce traffic injuries and air pollution. However, emphasis on the urgency of prioritizing health protection and promotion and the aim of protecting and promoting health is not often articulated, except in select recent SUMPs (Table 3). Health is often mentioned in the vision (e.g. healthy city, healthy mobility, a better urban environment for a healthy lifestyle), especially in the more recent documents. There is not always a clear-cut definition presented for what constitutes a healthy city. Few documents have sections specifically dedicated to health. Of these, some focus on environment and health and well-known pathways such as road traffic injury, air pollution and noise (e.g. Antwerp and Île-de-France), while a few touch on other pathways such as physical activity and green spaces (e.g. Delft, Oxfordshire

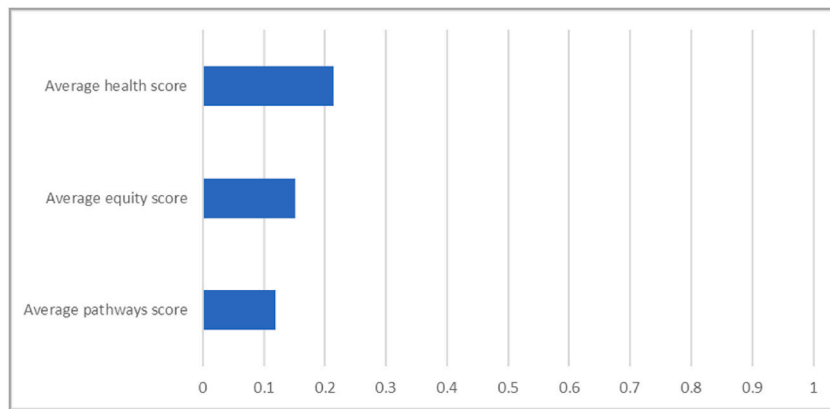


Fig. 5. Overall average score per sub-dictionary for all SUMP's across all countries in dataset, normalised.

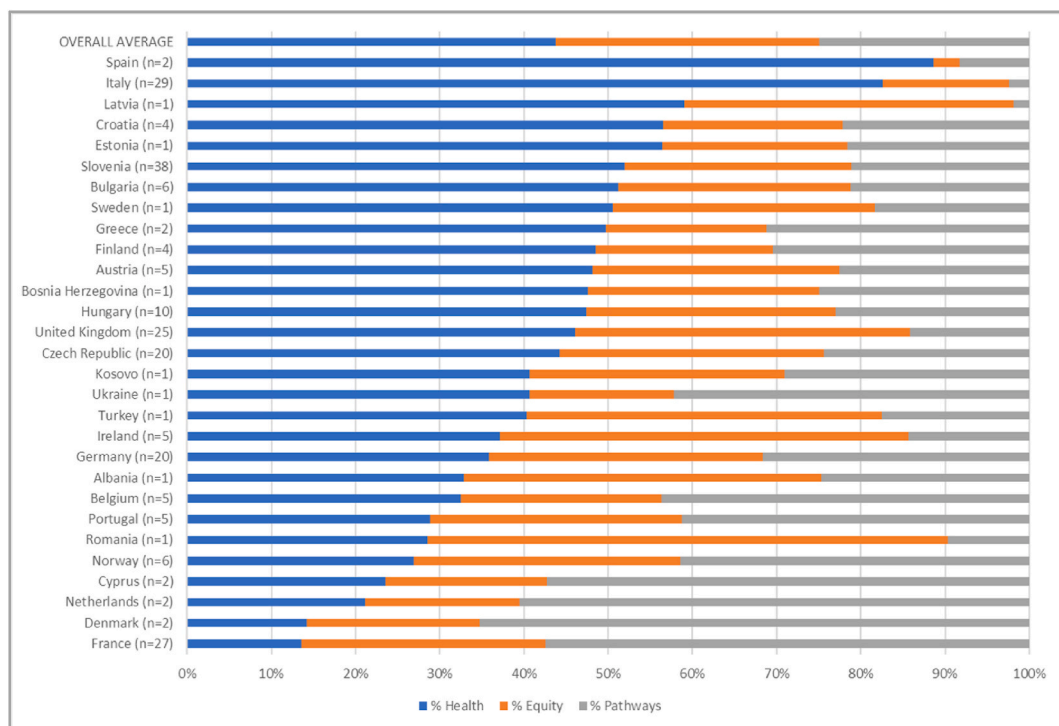


Fig. 6. Relative focus on health vs equity vs health pathways words in SUMP's, by country, from highest to lowest share of focus on health. Note: Lithuania and Serbia not shown due to scores of 0 for each dictionary.

and Vienna).

3.2.2. Health as an objective in SUMP's

Health on its own is scarcely mentioned as an objective. While many of the objectives have health implications, their link to health is not explicitly underlined. Few SUMP's, (e.g. Oxfordshire, Southampton, Vienna) specifically emphasise health *promotion* as their objective, some, like Île-de-France only mention health *protection* and safeguarding the quality of life (Table 4).

3.2.3. Transport pathways to health

Road traffic injuries are the most mentioned detrimental pathway to health, followed by **air pollution** and **noise**. Some documents have highlighted the impact of transport-related air pollution on health, especially cardiovascular/respiratory diseases, and the effect of transport-related noise on sleep and behaviour. The role of transport in all three pathways is well-known and implied (Table 5).

Table 3
Examples of SUMPs with a dedicated section on health.

City	Explanation
Antwerp	Has a subsection on Environment and health, almost exclusively focusing on strategies for reducing noise exposure.
Delft	Has a section on "social aspects of mobility", including the subsection "mobility and health" where the link between active travel and green spaces and health is explained. There is also a subsection on "transport poverty", but the health consequences of the issue are not discussed.
Île-de-France	Has a section dedicated jointly to health and the environment, focusing only on protection from detrimental impacts of transport (air pollution, noise and road traffic injury) and does not mention opportunities for health enhancements (e.g. physical activity, green spaces).
Oxfordshire	Has 'health' as one of the six themes of its vision. Most of the policies defined have a subsection dedicated to health, including a policy focus area on "Healthy place shaping".
Vienna	Has a section on a specific objective of being healthy, explaining the effects of active mobility on noncommunicable diseases, the opportunities for encounters and communication as well as the goal to further reduce traffic-related fatalities, pursuing a Vision 0 approach.

The role of transport in producing CO₂ and other **greenhouse gases** and their contribution to climate change is discussed at some level in most SUMPs. However, the potential health consequences of the resulting climate change are not explained.

While walking and cycling are referred to frequently, **physical activity** (PA) as a pathway to health and health outcomes of physical (in)activity are less emphasised, except in few cities (Table 6). When mentioned, its link to transport is implied as physical activity is almost always mentioned in combination with active travel modes, i.e., walking and cycling.

All SUMPs mention the desire to increase **access** in one way or the other. Some SUMPs discuss access in terms of number of opportunities reachable to people (Table 7). However, access to healthcare or to healthy food, which have important implications for health and wellbeing, are scarcely mentioned. The need to provide access for people with disabilities, vulnerable transport and/or public space users is also established in many documents without an explicit discussion on its health implications (Table 8). When discussing the need to increase access for vulnerable people, the focus is almost exclusively on reducing barriers through changes in the built environment; the social environment is overlooked. For example, SUMP in the purposive sample lack any mention of the deterrent role of perceived fear of crime and harassment during active travel or public transport use for vulnerable groups which can lead to social exclusion. An exception is Delft, which briefly mentions the aspect of social safety (Table 9). Many SUMPs discuss the need for increased **mobility independence** directly or indirectly. This concerns the (vulnerable) population's ability to travel independently with their mode of choice. However, the link between mobility independence and health is rarely established. An exception is Tampere (Table 10). **Community severance**, which refers to the division of communities and limitation of access to opportunities due to obstructive infrastructure is hardly mentioned. However, reduced social interactions, or **social exclusion**, which is highly correlated with community severance (Boniface et al., 2015), are touched upon in around half of the SUMP (Table 11). The implications of social exclusion for health are also missing. Finally, most SUMP touch on planning for inclusivity and **equity**, however the health outcomes of these pathways are usually not made explicit.

The link between transport and **green and blue spaces and aesthetics** and health is not often highlighted, though there are some mentions of how green spaces can improve quality of life. Most plans mention creating an attractive and liveable urban environment in their vision. However, there is rarely a discussion on how to do that or what the health implications would be. **Blue spaces** are overlooked. Oxfordshire discusses the importance of green spaces for attractive and healthier places, and Vienna includes a section titled "Public space: sharing streets in a fair way". Delft is one of the very few documents that discuss the role of the reduction of transport space in providing opportunities for street restructuring, greenspace and better public space (Table 12).

The link between transport and mental health in general, and **stress** specifically, is rarely discussed in the SUMP. Exceptions are Delft, which mentions stress in relation to active mobility, and Oxfordshire, which touches on mental health (Table 13). While relaxation is mentioned a few times, it is mostly in the sense of places for resting as opposed to movement (e.g. Delft and Antwerp).

Urban heat islands are not mentioned in the reviewed SUMP. References to the contamination and electromagnetic field pathways are also missing.

Fig. 7 consolidates the analysis of the transport pathways to health in the purposive sample. Here, pathways are grouped based on the extent to which i) a health pathway is highlighted (X axis), and ii) its impacts on health are highlighted (Y axis).

Table 4
Sample SUMP with health as an objective.

City	Sample quote
Île-de-France	"The challenge of the [SUMP] is to ensure a sustainable balance between mobility needs and environmental and health protection. This balance must promote the attractiveness of Île-de-France and guarantee the region's social cohesion."
Oxfordshire	"Our Local Transport and Connectivity Plan vision is for an inclusive and safe net-zero Oxfordshire transport system that enables all parts of the county to thrive. It will tackle inequality, be better for health, wellbeing and social inclusivity and have zero road fatalities or life-changing injuries."
Southampton	"Improving people's health and quality of life" is one of the main four objectives of the plan. This is also highlighted as a goal to achieve "an Active and Healthy City that is easy to get around with joined up networks for active travel to promote healthy lifestyles and has vibrant people friendly liveable neighbourhoods"
Vienna	Being fair and healthy are two of the plan's six main objectives: Health goal: "The share of people in the Viennese population who are actively in motion for 30 min daily as they run their daily errands is to rise from 23% in 2013 to 30% in 2025. The number of traffic casualties and persons injured in traffic accidents [sic] declines further."

Table 5
Sample SUMPs highlighting the road traffic injuries, air pollution and noise pathways.

City	Sample quote
Île-de-France	"Transport has a major impact on people's health. Road safety is a direct cause of injury, disability and premature death. The health of the population is also very closely linked to the quality of the environment, particularly through air, soil and water pollution, as well as noise pollution. [...] There is no threshold below which atmospheric pollution has no effect on health, and there is a correlation between exposure to air pollution and mortality. Noise is responsible for health impacts of various kinds: direct impacts on hearing, but also on general state of health (sleep disturbance, behavioural effects, etc.) directly linked to the discomfort experienced."
Southampton	"Exposure to particulate matter (both PM2.5 and PM10), which are fine particles including soot and dust from road traffic, can cause the most serious health problems among those susceptible groups with pre-existing lung or heart disease, the elderly [sic] and children. There is evidence that short and long-term exposure to particulate matter causes respiratory and cardiovascular illness and even death. Particulate matter is predicted to contribute to an estimated 110 early deaths in Southampton each year. Source apportionment work has identified that road transport is one of the largest contributors to air pollution in Southampton."

Table 6
Sample SUMPs highlighting the physical activity pathway.

City	Sample quote
Oxfordshire	"In children, regular physical activity is associated with improved learning and attainment, better mental health and cardiovascular fitness. It also reduces sickness absence and can reduce crime and anti-social behaviour. In adults, there is strong evidence to demonstrate that physical activity can help to protect from a range of chronic conditions including coronary heart disease, obesity, type 2 diabetes, Alzheimer's and social isolation. Physical activity has also been shown to improve mental health. Those who walk for more than 8.6 min per day are 33% more likely to report better mental health."
Tampere	"A municipality resident who exercises regularly creates less costs for society. Increasing incidental exercise can affect the risk of many national diseases, functional ability and sick leave. [...] Everyday physical activity promotes well-being and health and decreases the costs caused by physical inactivity. [...] Cycling is excellent health-enhancing physical activity. Cycling five kilometres in both directions meets the recommended daily amount of physical activity."
Vienna	"Active mobility, i.e. walking and cycling, demonstrably improves people's health. A lack of exercise is a main risk factor in many diseases and disorders, such as back and joint aches, cardiovascular diseases and type II diabetes. People who frequently cover above average distances not only reduce their disease risk, they also help avoid health care costs."

Table 7
Sample SUMPs highlighting access to opportunities.

City	Sample quote
Oxfordshire	"Developing accessible 'Local Community hubs' where a range of services, activities, and opportunities are focussed, will lead to greater social cohesion, reduce the need to travel, and support the 20-min neighbourhood initiative."
Sofia	"A key condition for further growth and development of Sofia is the accessibility and connectivity of the city. People need easy and safe access to workplaces, schools, public spaces, parks, services and entertainment, regardless of age, sex, health status and income."
Southampton	"It is important that people of different backgrounds and abilities do not encounter barriers that cause them difficulties or restrict their options for travelling around. We need to ensure that people from all backgrounds can access the same employment, health, leisure and education opportunities."

Table 8
Sample SUMPs highlighting access for vulnerable groups.

City	Sample quote
Antwerp	Focus on "those victims [sic] who are overrepresented in traffic fatality statistics: the older adults, people in their twenties, and children", and promoting "obstacle-free pedestrian and cycle paths, especially during road constructions and in bad weather conditions."
Hannover	Specific goals on "Opportunities for mobility for all: 1) special attention to the needs of women, children, older adults, migrants, people with a handicap or socially disadvantaged people in transport planning 2) promotion of alternatives to driving on all travels 3) barrier-free participation in public life for all transport modes"
Vienna	"Many steps were taken in making the transport system barrier-free. Kerbstones at nearly all intersections were lowered, barrier-free public transport was stepped up, acoustic traffic lights and tactile guidance systems were set up and experts from organisations representing the interests of people with restricted mobility are involved in building projects."

Table 9
Sample SUMP highlighting the issue of social safety.

City	Sample quote
Delft	"Making the city inclusive is an integral task. This does not only concern the physical environment, but also the social environment of people with mobility limitations." "To get home safely as a cyclist, social safety is also important. Users can make known in which places they do not feel (socially) safe."

Table 10
Sample SUMP highlighting mobility independence.

City	Sample quote
Tampere	"Safe school routes support children's opportunities for independent mobility." "In an accessible environment, all people can operate equally and independently regardless of their mobility or functional ability." "An accessible environment makes independent mobility easier and enables living at home for longer, which increases quality of life and creates service cost savings for the city."
Turin	"Every child should have the right to a safe and independent journey to school on foot, by bike or using public transport." "The urban mobility system should allow everyone to exercise their right to move, without burdening, as far as possible, the community in terms of air pollution, noise, congestion and traffic fatalities." "The application of the principle of urban accessibility makes it possible to contain and reduce to the point of eliminating obstacles, sources of danger and situations of fatigue and discomfort not only for disabled people, but for everyone, especially for those who due to advanced age and therefore physical or sensory limitations, their ability to circulate autonomously is compromised."

Table 11
Sample SUMP highlighting social exclusion.

City	Sample quote
Île-de-France	"Social disparities are great in Île-de-France, and the share of the population in difficulty is far from negligible. [...] Adapting transport systems so that they respond as a priority to these populations is essential" "So that people with reduced mobility can participate in social life, it is the entire chain of travel, roads and public transport, which must be made accessible."
Oxfordshire	"In this way 20-min neighbourhoods address some of the drivers of health inequality, with residents who may have felt socially excluded able to access the services that they need in a sustainable way and in a welcoming environment." "Buses help tackle loneliness and social isolation, keeping people in touch with their friends and families."

Table 12
Sample SUMP highlighting green spaces and aesthetics pathway.

City	Sample quote
Delft	"We want to encourage movement also more space for greenery and resting. This stimulates outdoor sports and (recreational) walking and cycling. It also offers a good living environment and sufficient green space for relaxation and space to meet each other. This has a positive effect on well-being." "With the freed up space, we can increase the quality of the public space. This can then benefit the liveability of the (inner) city."
Oxfordshire	"The protection, maintenance and enhancement of Green Infrastructure is required in Oxfordshire if we are to deliver our vision for air and environmental quality, healthy places and increased walking and cycling. The GI network is multifunctional and a core part of Oxfordshire's 'living landscape' of attractive and healthier places."
Tirana	Mentioned in relation to "quality of public spaces" ... expected to have an increase in "The average reported satisfaction of green (parks, gardens) and non-green (markets, squares, pedestrian areas) public spaces."
Southampton	"Develop and promote networks of green infrastructure (open spaces, parks, wooded areas, nature reserves, waterfront areas and country parks) to support quality of life and wellbeing."

3.2.4. Operationalising health: targets and KPIs

Direct health targets and KPIs like disability-adjusted life-year (DALY) or years of life lost (YLL) are largely missing (YLL is only mentioned in Southampton and Oxfordshire). However, all the reviewed SUMP include some form of health-related targets and KPIs. Almost all documents contain concrete targets for increasing road safety and reducing road injuries and mortality, including zero road fatality goals in the long term. Similarly, most SUMP have targets for reducing air pollutants (e.g. PM10, NO2) based on national limits or EU limits, and specify target levels for noise reduction. Many SUMP have GHG reduction targets and some strive to become carbon neutral (Tampere) or have a net-zero transport network (Oxfordshire by 2040) in the long term.

Some SUMP include active mobility targets which can relate to increasing physical activity (e.g. targets on the share/amount of active travel). However, very few SUMP attempt to specify a preferred level for physical activity *per se*. Targets to improve accessibility (access to opportunities, social exclusion, mobility independence) are often described in general terms (e.g. increase access, decrease social exclusion) and detailed target levels are harder to come by here. Targets for enhancing green spaces and aesthetics are even more abstract (e.g. enhance attractiveness) and hardly operationalised.

Table 13
Sample SUMP highlighting stress pathway (Delft) and the mental health outcome of transport mode (Oxfordshire).

City	Sample quote
Delft	"The way we move affects our health. Research shows that people who take public transport to work, have fewer health problems than have people who travel by car. The cause is twofold. On the one hand, public transport travellers experience less stress, on the other hand, public transport travellers often spend part of their journey on foot or by bicycle, which gives them more exercise than normal average motorist."
Oxfordshire	"Those who walk for more than 8.6 min per day are 33% more likely to report better mental health."

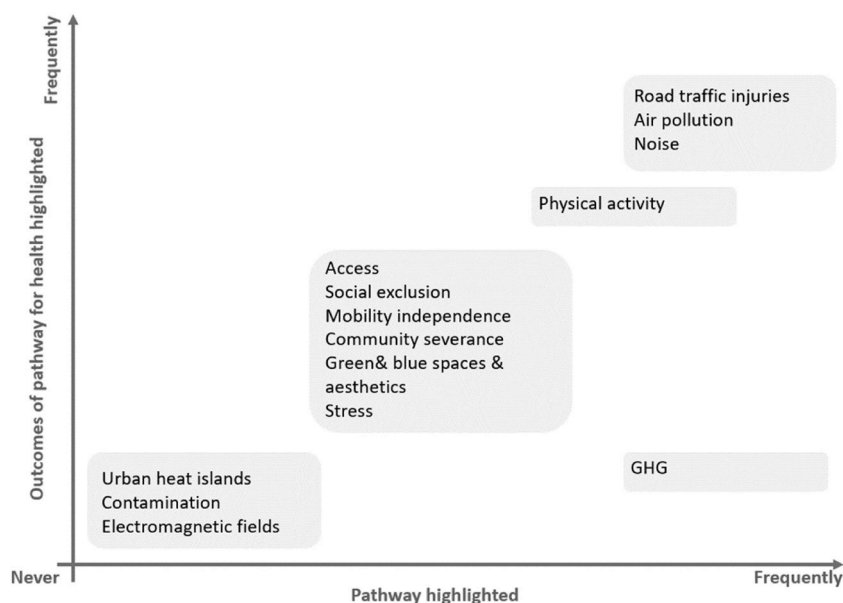


Fig. 7. Transport's pathways to health highlighted in the purposive sample.

The majority of SUMPS have long term health-related targets and goals, but they do not mention how these will be achieved. However, there are a few plans that specify targets and KPIs to meet and measure along the way (e.g. Oxfordshire has a long-term plan set to 2050 with targets for 2030, 2040 and 2050).

Many SUMPS include measures aimed at increasing road safety and reducing injuries (e.g. speed limits, traffic calming elements, pedestrianisation of some centres). Most SUMPS describe measures for reducing air pollution. Solutions include a shift towards less polluting modes of transport, clean air zones and zero emissions zones, improvements in vehicle technology and phasing out diesel and petrol vehicles. Noise measures aim to reduce the number of residents exposed detrimental noise exposure (e.g. noise barriers along major roads).

PA-related measures focus on increasing active travel share/amount and providing a network of safe and continuous pedestrian/bike infrastructure. Some documents recommend campaigns and educational programmes to promote active travel. The relation between PA-related measures and health is occasionally explained but not consistently.

The measures to increase access range from integrated land-use transport interventions (e.g. 'local community hubs', '20-min neighbourhood' suggested in Oxfordshire) to reducing barriers (for the vulnerable people) by changes in the built environment (e.g. barrier-free pedestrian/cycle paths and public transport, lowered kerbstones at intersections, acoustic traffic lights and tactile guidance systems in Vienna). No specific measures were found on how to improve green and blue spaces and aesthetics and to decrease stress. However, some suggested traffic calming schemes can potentially help achieve this (e.g. network of green routes with resting opportunities). Annex 6 and Annex 7 list sample health-related targets and KPIs from the reviewed SUMPS.

In general, the health-rationale of many measures and how exactly they can contribute to health objectives are not stated explicitly (see two exceptions in Table 14). One exception is Vienna, which outlines the expected contribution of fields of actions and measures to each of its objectives (including "healthy" and "fair"). The expected contributions are categorised into: i) small or no contribution, ii) mid-sized or indirect contribution to the objective, and iii) major contribution to the objective.

Oxfordshire's recent plan is the only one to include a HIA (Table 15). This plan has HIA as part of an Integrated Sustainability Appraisal (ISA) that mandates a rapid or full HIA for all major infrastructure proposals and major transport schemes or plans.

4. Conclusions and discussion

This article assesses the extent to which health is reflected in SUMPS in European cities, in particular with regards to: i) the presence of key health and health equity terminology, ii) how explicit transport pathways to health are made, iii) whether health is operationalised into targets and key performance indicators (KPIs), and iv) how well elaborated is the health-rationale of various actions and measures.

The analysis shows that health is often touched upon in SUMPS across Europe, and its prominence seems to be increasing. While some cities emphasise health explicitly in their mobility planning, others still do not. Cities emphasise health in general terms more than equity and health pathways. Cycling, accessibility and security/safety are the top most frequent health-related words present across SUMPS, and are mentioned more than terms containing the word "health" itself. Interestingly, cycling is mentioned nearly twice as often as walking. When health is discussed, the focus is on physical health while social and mental wellbeing receive much less attention. Although many SUMPS touch on equity, the fact that transport and its related policies could have unequally distributed

Table 14

Sample SUMPs providing a health rationale for their targets and measures.

City	Sample quote
Delft	"With the freed up space, we can increase the quality of the public space. This can then benefit the liveability of the (inner) city."
Oxfordshire	"Improve public health and wellbeing by increasing levels of walking and cycling, reducing transport emissions, reducing casualties and enabling inclusive access to jobs, education, training and services."

Table 15

Sample SUMP addressing health impact assessment (HIA).

City	Sample quote
Oxfordshire	"HIAs provide a systematic framework to identify the potential impacts of an infrastructure proposal on the health and well-being of the population and highlight any health inequalities that may arise. HIAs can highlight mitigation measures that may be appropriate to enable new infrastructure to maximise the health of communities. Requiring the use of HIAs and embedding their use into the design process will ensure that future development and improvements to the transport network across Oxfordshire positively impacts on existing health inequalities and creates healthy, more resilient and sustainable communities. The use of HIAs will also provide a mechanism for putting the healthy place making principles into practice and delivering improvements to health and well-being."

health impacts across space and society which need to be addressed is seldom made clear. Most SUMPs recognise the need to protect against harmful effects of transport, but few recognise explicitly the opportunity for health enhancement through transport policy. Most SUMPs elaborate on **road traffic injuries**, **air pollution** and **noise** health pathways which have been recognised in the transport literature for a long time. The role of transport in producing CO₂ and other **Greenhouse gases** and their contribution to climate change is recognised at some level in most SUMPs, although health-related implications are missing. While cycling and walking are referred to frequently, **physical activity** as a pathway to health and its health outcomes are less emphasised. The pathways of **access**, **social exclusion**, **mobility independence**, **green spaces** and **aesthetics** are touched upon, but their health outcomes are not made explicit. **Blue spaces** and their health implications are almost completely overlooked, which is reflective of the more scant research on blue spaces compared to green spaces. When discussing access, the focus is almost exclusively on reducing barriers, primarily for vulnerable people, by changes in the built environment (e.g. obstacle-free pedestrian and cycle paths), and the social environment is not addressed. The link between transport and **stress** and its health consequences are rarely discussed. The role of transport in **urban heat islands**, **contamination** and **electromagnetic fields** and their health outcomes are missing, reflecting the very scant evidence in the literature on these topics. Direct health targets and KPIs like disability-adjusted life-year (DALY) or years of life lost (YLL) are largely absent but all the reviewed SUMPs include some form of health-related targets and KPIs. Most, however, represent long-term aspirational goals rather than nearer-term targets. Even where targets are present, they are rarely accompanied by monitoring approaches to check progress. The health rationale of the suggested actions and interventions and their health outcomes in terms of increased or decreased physical, social, and mental well-being are often not made explicit. Where health-related targets are present, most SUMPs are not explicit about the types of interventions that will be put in place to achieve them. In general, we find that SUMPs miss out on the opportunity to embrace mobility as a driver of health promotion. Overwhelmingly SUMPs' health aspirations are concerned with mitigating detrimental impacts of transport on health, primarily from traffic injuries and to a lesser extent from air pollution. Health related concepts such as accessibility and active travel feature prominently but are never seen as an opportunity to enhance health.

4.1. Discussion

4.1.1. More attention to cycling compared to walking

Our analysis shows that cycling is mentioned nearly twice as often as walking. This overwhelming focus on cycling over walking can be attributed to a set of factors, including existing infrastructure disparities, prevailing travel patterns, and the influence of cycling advocacy. Many cities have basic pedestrian infrastructure, such as sidewalks and crosswalks, albeit often inadequate or in need of improvement (Ewing and Cervero, 2010; Shields et al., 2021). However, dedicated cycling infrastructure, such as protected bike lanes and secure parking facilities, still often remains underdeveloped or entirely absent (Pojani and Stead, 2015; Pucher and Buehler, 2017) and thus in need of specific policies. In addition, walking constitutes a more common mode for short trips in many urban areas, particularly related to often well-developed local public transport (Goel et al., 2023; Pisoni et al., 2022), thus may not be perceived as needing more attention in mobility plans relative to cycling needs. The growing influence of cycling advocacy groups may also play a role in raising awareness of the benefits of cycling and influencing political decisions in favour of cycling-friendly measures (Aldred, 2012). An earlier analysis of how supportive urban policy environments were toward cycling or walking also confirmed that these are usually separate policy areas (Kahlmeier et al., 2021).

4.1.2. Health pathways' coverage and state-of-the-art evidence base

Interestingly, SUMPs' attention to various health pathways of transport is not always in line with the state-of-the-art evidence base. For example, despite a robust evidence base, **physical activity** as a pathway to health and its health outcomes are rarely explicitly expressed. The evidence on pathways like **access**, **social exclusion**, **mobility independence**, **green spaces** and **aesthetics** and **stress** has been growing for a while (Conceição et al., 2023; Glazener et al., 2021). However, their health implications are not emphasised in

SUMPs. Similarly, while the detrimental health impacts of **Urban heat islands** and the climate changes implications of transport-related **green house gases** are well-known, how they can endanger health is not made clear. Climate change, can directly impact both transport infrastructure and human health (Markolf et al., 2019). Climate change impacts health by leading to increased fatalities and illnesses through more frequent extreme weather events like heatwaves, wildfires, storms and floods, disrupted food supply chains, higher pollen and zoonotic disease rates. The detrimental health effects of air pollution, urban heat islands and physical inactivity can be worsened by climate change, and the displacements engendered by it can result in adverse mental and physical health (Glazener et al., 2021).² Making the various pathways explicit can significantly aid sustainable urban planning. This will help with explaining the relevance of different sectors for each other and creating an impetus for collaborations and alliances across various government departments and officers, leading to improved solutions for health and beyond (de Nazelle et al., 2021; Negev et al., 2022).

4.1.3. The significance of including health concepts

Our analysis shows that the inclusion of health in SUMPs shows a slight upward trend in the past 20 years. The mere mention of health and prominence of health and equity concepts in some SUMPs is an encouraging sign of recognising the impacts of transport in urban planning practices. These impacts have long been established in scientific literature (see *Introduction* section), but it seems the evidence-base struggles to find its way into transport and planning practice (see previous discussion point and Negev et al., 2022). Including conceptions of health into planning documents does not necessarily indicate that measures in place in a local area are indeed health-promoting, and in reverse the absence of such concepts does not indicate that measures in place are not health-promoting. Including health concepts, however, can be an indication of breaking silos, and is certainly an opportunity to break silos across government departments and sectors. Developing mechanisms for collaboration and highlighting common goals across departments are key to creating holistic approaches to urban planning that will help promote health and equity in cities (de Nazelle et al., 2021; Negev et al., 2022). In reverse, continuing to conceive of health and health pathways as separate entities to transport and urban planning runs the risk of perpetrating a siloed approach to decision making (Negev et al., 2022). The opportunity for a holistic or systemic approach to tackle health through mobility plans is thus missed.

4.1.4. Need for explicit health targets, monitoring and health impact assessment (HIA)

Our analysis reveals that direct health targets and KPIs, such as DALY or YLL are largely missing from SUMPs. Existing concrete health targets primarily focus on road traffic injuries, air pollution and noise, and when targets are established, they are rarely accompanied by monitoring approaches to check progress. Establishing concrete, measurable targets is crucial for prioritizing health in urban planning (Giles-Corti et al., 2022a). Without clear, quantifiable objectives and regular monitoring, the integration of health considerations into urban planning may remain aspirational rather than actionable. The absence of robust monitoring mechanisms further hinders the ability to assess the effectiveness of interventions and make necessary adjustments, ultimately impeding progress towards healthier and more sustainable cities.

Of the reviewed SUMPs, only Oxfordshire's plan includes HIA. HIA is a crucial tool for incorporating health considerations into decision-making processes and promoting a "health in all policies" approach. The inclusion of HIA within mobility plans improves the commonly used cost-benefit analyses in transport planning which often overlook health impacts. The presence of HIA within a SUMP can serve as a valuable indicator of the plan's acknowledgement of the health implications associated with transport. Its presence on its own, however, does not necessarily mean that concrete targets related to health are defined in SUMPs. By systematically identifying and evaluating the potential positive and negative health impacts of transport policies and projects (Nieuwenhuijsen et al., 2017), HIA allows for the integration of health considerations into the early stages of planning, promoting a proactive approach to health promotion. The exclusion of HIA from planning processes is often attributed to time constraints, political will, the need for interdisciplinary collaboration, differing evidentiary standards between sectors, and the complexity of HIA findings and long-term monitoring requirements (Carmichael et al., 2012; Lozzi and Monachino, 2021). These challenges may deter policymakers from fully integrating health considerations into SUMP plans in future.

4.1.5. The political context of SUMPs

Finally, the development of SUMPs can be strongly influenced by the political context such as national/regional government requirements and support and historical factors (Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology - Austria, 2021; Lanzendorf and Busch-Geertsema, 2014; Pucher and Buehler, 2007; WHO Regional Office for Europe, 2022).

At the European level, the growing evidence-base and health framings of transport in the 1990s eventually led to the Charter on Transport, Environment and Health adopted in 1999 at the Third Ministerial Conference on Environment and Health. In 2002, the Health and Environment Pan European Programme (THE PEP) was adopted with the support of the United Nations Economic Commission for Europe (UNECE) and WHO/Europe. The PEP's work plan has been adopted ever since through consecutive High-level Meetings on Transport, Health and Environment (UNECE, n.d.). For cycling in particular and its links to health, some countries have demonstrated political support by participating in THE PEP Partnership on Cycling, while two members even have active travel

² Some plans conflate GHG emissions with air pollution. While the reviewed SUMPs primarily focus on air pollution mitigation strategies, which often also address GHG emissions, it is crucial to distinguish their distinct health impacts and pathways. GHGs mainly contribute to long-term climate change with indirect health effects, while air pollutants like particulate matter cause immediate and localised health problems.

experts in their ministries of health (Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology - Austria, 2021).

At the national level, certain political parties explicitly promote the link between environmental policies and public health, sometimes specifically mentioning impacts from transport (Department for Environment F, 2019; Labour Party - UK, 2023; Ministère de la Transition écologique et de la Cohésion des territoires - France, 2024). In some cases, political mechanisms specific to a location can result in policy favouring healthier modes of transport, such as Switzerland's use of a popular vote to amend its constitution to include principles for active travel (WHO Regional Office for Europe, 2022).

Also, historical and cultural factors play a role. For example, in the Netherlands, local politics, policies, and conditions for cycling were influenced by public support and the positive image of cycling in the country in the late 19th and early 20th centuries. In contrast, in Germany, by the 1920s the bicycle had come to be viewed as an outdated, inferior technology, which contributed to a lower level of political support for cycling (Ebert, 2004).

Despite the growing robust empirical evidence-base and programs such as the PEP, health has been insufficiently incorporated in upstream policies for urban and transport planning (Giles-Corti et al., 2022b). Reasons include different understandings of the concept of health and of evidence-base in different sectors, challenges associated with research translation, siloed decision-making across government departments, competing interests pressuring policy-makers, and short-term electoral cycles, to name a few (Negev et al., 2022). The integration of health into urban and transport planning can be helped by revised institutional environments that encourage intersectoral collaboration and create alliances across sectors, and by greater engagement of health experts with politics (Riley and de Nazelle, 2019).

4.2. Limitations and future research

This article provides insights into the degree to which current SUMP address health. Several avenues for future research deserve more in-depth investigation. First, regarding the methods used, our quantitative analysis allows for general observations about the inclusion of health in European SUMP (or lack thereof) and some differences across countries and languages. However, further research could build on this work to refine the methods and conduct additional analyses. Additional research could further refine and expand our dictionary and explore the data for other elements, such as the position/proximity of terms, as well as other themes/concepts through additional sub-dictionaries. The dictionary translations could be validated for the languages that were not validated in this study. Additionally, the dataset could be expanded to include the observations that were left out due to texts not being easily available for extraction. Furthermore, future research could add stopwords and stemming for the missing languages in our dataset and explore the use of lemmatisation instead of stemming where applicable. While the methods used allowed for capturing multi-word expressions from the dictionary for scores, further research could employ n-grams to explore whether more meaningful combinations of words could be captured for top dictionary term frequencies (see Annex 4 for more detail). Second, each SUMP should be considered within the context of the political background at the time of its development. While this was out of the scope of our work due to the large number of SUMP analysed, future studies should take this into account. Third, most of the top cities on the measures presented in the quantitative analysis are located in the UK, and the UK also had the highest average cumulative score, including the highest health and equity scores compared to other countries. More research is needed to explain this phenomenon and whether it is due to greater awareness of health and equity impacts of transport or other factors such as language trends. Fourth, the presence of health concepts in SUMP, while indicative of awareness of impacts of mobility strategies, does not necessarily indicate that the plans have or can effectively improve health. Further research is needed to scrutinise the extent to which SUMP have been effectively implemented to assess their health implications, and whether the presence of health concept in SUMP bears any relationship with health in the local population. Such an evaluation could also help develop guidance on how to enhance effectiveness of SUMP in promoting healthier urban environments. Finally and related to the previous point, future research need to examine how arguments for health co-benefits can help create alliances across sectors and engagement a variety of stakeholders, including marginalised communities, in the development and implementation of SUMP.

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CRedit authorship contribution statement

Dena Kasraian: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Project administration, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Hannah E. Murdock:** Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Ahmadreza Faghih Imani:** Writing – review & editing, Writing – original draft, Validation, Project administration, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Yurong Yu:** Writing – review & editing, Visualization, Methodology, Formal analysis, Data curation. **Audrey de Nazelle:** Writing – review & editing, Writing – original draft, Validation, Supervision, Methodology, Funding acquisition, Formal analysis, Conceptualization. **Dominic Stead:** Writing – review & editing, Writing – original draft, Validation, Supervision, Methodology, Funding acquisition, Formal analysis, Conceptualization. **Sonja Kahlmeier:** Writing – review & editing, Writing – original draft, Validation, Supervision, Methodology, Funding acquisition, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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