International Platform of Registered Systematic Review and Meta-analysis Protocols

INPLASY

INPLASY202420011
doi: 10.37766/inplasy2024.2.0011
Received: 02 February 2024
Published: 03 February 2024

Success factors in the case of transport interventions: A mixed-method systematic review protocol (1990 – 2022)

Pierré Esser, MBA[1] ● Shehani Pigera[1] ● Doctor Miglena Campbell[1] ● Professor Doctor Paul Van Schaik[1] ● Professor Doctor Tracey Crosbie, DOS[1]

Corresponding author:
Pierré Esser

p.esser@tees.ac.uk

Authors:
Shehani Pigera
s.pigera@tees.ac.uk

Doctor Miglena Campbell
mia.campbell@tees.ac.uk

Professor Doctor Paul Van Schaik
p.van-schaik@tees.ac.uk

Professor Doctor Tracey Crosbie, DOS
t.crosbie@tees.ac.uk

Author Affiliation:
[1]School of Social Science, Humanities and Law SSSHL, Teesside University, Middlesbrough Tees Valley, TS1 3BX UK

ADMINISTRATIVE INFORMATION

Support - As the PhD program at Teesside University is self-funded by the research student himself this systematic review is part of the PhD program and therefore financed by the first author Pierré Esser. There are no further monetary sources or sponsors to credit.

Review Stage at time of this submission - completed but not published.

Conflicts of interest - None declared.

INPLASY registration number: INPLASY202420011

Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 03 February 2024 and was last updated on 08 February 2024.

Additional note: This protocol is not an update of a former produced systematic review. Thus, the protocol is eligibly a piece of work in its own right.

INTRODUCTION

Abstract **Introduction:** At present Germany is the country with the biggest share of carbon dioxide emissions among the 27 countries' transport sector within the European Union. To mitigate climate-threatening consequences Germany has to monitor its transport induced carbon dioxide emissions. Interventions are able to contribute to the overall carbon dioxide emissions reduction caused by cars. In literature the prevalence of longitudinal evidence on interventions aiming at car use and car dependency reduction seem to be remarkably low. Thus, it is regrettable that once transport related interventions have been developed or implemented less is known about how the success of interventions can be evaluated over time.

Aim and objectives: Therefore, the overarching aim of the systematic literature review is to summarise the literature on transport interventions. The review's scope is to identify interventions which encourage car users to

use more environmentally friendly modes of transport, to identify and determine any success factors of interventions underpinning the modal shift to modes of transport that generate less carbon dioxide. Hence, findings can report on intervention's success factors such as mile age travelled, frequencies of car-use, number of trips taken, expenses by individuals on refuelling, emissions per person. As a secondary outcome the planned systematic literature review attempts to summarise the literature on behavioural mode choice models

Methods and inclusion criteria: The present protocol follows the Preferred Reporting Items for Systematic Reviews and Meta-Analysis Protocols (PRISMA-P) guidelines and was developed in accordance to the JBI Manual for Evidence Synthesis provided by the Joanna Briggs Institution for a mixed-methods review protocol using a convergent integrated approach. To identify the body of literature the following electronic databases will be searched: Scopus, Web of Science, MEDLINE (PubMed), APA PsycInfo, ProQuest. A publication date filter will be applied so published and peer-reviewed articles will range from the international reference year 1990 officially stated within the Kyoto protocol onwards. Identified articles will be screened by the first author, while about 10% will be independently screened by a second reviewer. Disagreements will be resolved through full-text screening and discussion until a consensus is reached or a third reviewer's decision will end the process. Studies meeting the predefined inclusion criteria will be included and quality-appraised by using the Quality Assessment Tool for Studies with Divers Designs (QATSDD). The data will be obtained by using the JBI mixed-methods data extraction form following a convergent integrated approach. In order to obtain all data relevant to the review question the JBI extraction form will be redesigned and customised in Covidence.

Keywords: sustainable transport, mass transit, interventions, travel behaviour, car-use behaviour, modal shift

In order to fulfil all requirements with utmost rigour and in order to work compliantly according to common disseminated acknowledged guidelines the systematic literature review protocol will be registered on the International Platform of Registered Systematic Review and Meta-analysis Protocols INPLASY. The registration with the registration number INPLASY202420011 will be completed on 02 /February/2024.

Introduction The importance of the shift from high-CO_2 modes of transport, for instance cars to more low-carbon modes of transport is gaining prominence and much attention within the recent published literature. So far, there have been many attempts made to fully understand personal car-use behaviour in order to accomplish individuals' behaviour to change (Chng 2018, Pronello 2018). This paper expects individual's mode choice to become a hot topic of interest for Germany, as each sector covered by the United Nations Framework Convention on Climate Change (UNFCCC) common reporting format (CRF) (United Nations Climate Change 2013) reports on a reduced amount of its carbon dioxide emissions, except for transport (Umweltbundesamt 2021). In 2020, the total carbon dioxide emission of Germany's transport sector was 162.5 million tonnes which is by far the biggest share among the 27 countries' transport sector within the European Union (Commission 2022).

The far-reaching consequences, whether global or local, range from toxic and harmful emissions that contribute to global warming, to irreversible damage to the natural and human ecosystem or habitat, to serious health problems such as respiratory diseases caused by air pollution especially in Germany's densely populated areas and urban metropolises (Weiand 2019, Hunecke 2021, Steg 2007, Lorenzoni 2007). There have been significant observations made by the World Meteorological Organization (WMO) which have shown the irreversible damage to the natural system, for instance the rise of the average global surface temperature up to 1.1 Celsius above pre-industrial levels in 2017 (World Meteorological Organization (WMO) 2018), the increase of the rise in annual global mean temperatures from 1,15 Celsius to 1,28 Celsius in 2020 and the fact that for Europe 2020 was the warmest year on record since record keeping of the second half of the 19th century (World Meteorological Organization (WMO) 2020).

Over the past years the carbon dioxide emissions of Germany's transport sector have shown to be volatile for many reasons (Umweltbundesamt 2021). In 1999 the emitted carbon dioxide went up to 184 million tonnes and begun sinking again shortly after due to a shift in consumer behaviour, refuelling in neighboured countries and the substitution of gasoline through (bio)diesel. The fall of carbon dioxide emission continued throughout the years until an emitted volume of 153 million tonnes was achieved in year 2007. Then carbon dioxide emission stagnated because of technological progress which led to an increased engine power. In the years of 2013 the carbon dioxide emission began to increase again because of individuals' increased mileage demands and therefore mileages travelled. In addition, the demand for and use of

biodiesel was reduced. Only once (in 2020) did carbon dioxide emissions decrease, which is likely to be related to the SARS-Cov-2 pandemic.

In comparison to Europe, Germany's overall carbon dioxide emission was totalling 2,688.0 million tonnes, while the whole transport sector solely counted 888.8 million tonnes (28,6%) in 2020 (Commission et al., 2022). Hence, transport had beside the energy sector the largest share of carbon dioxide emission. Therefore, a significant amount of carbon dioxide emissions was caused by mobility. To be even more accurate, road traffic was 681,6 million tonnes of emitted carbon dioxide, while the emissions caused by cars only were totalling 405,6 million tonnes (Commission et al., 2022). Hence, 76.7% of total transport carbon dioxide emissions were caused by motorized road traffic and 45.6 % of total emissions from transport were caused by car-use (Commission et al., 2022).

Similar to Germany's carbon dioxide emissions, these emissions are also volatile in Europe. The amount of emitted carbon dioxide emissions within the basis year were totalling 815,6 million tonnes (Commission et al., 2022). The peak was reached in 2019 with 1.092,3 million tonnes while a downwardly trend occurred one year later so the carbon dioxide emissions were 888.8 million tonnes (Commission et al., 2022).

The systematic literature review's purpose is to investigate what interventions enable car-users to use more environmentally friendly modes of transport, for instance public transport in order to contribute to Germany's reduction in carbon dioxide emissions. Therefore, the systematic literature review is guided by the following research question which scope is supported by a fixed set of objectives:

> [RQ1] Which interventions have been designed to encourage car-users to a frequent usage of sustainable modes of transport?
>
> [OBJ1] to identify any developed and implemented interventions designed to capitalise on drivers and overcome barriers with results.
>
> [OBJ2] to identify any success factors of interventions within the literature which demonstrate the interventions' usefulness with respect to an occurring modal shift from cars to less carbon dioxide-emitting modes of transport and the measurement and tracking of these success factors.
>
> [OBJ3] to identify psychosocial enablers and barriers which are linked to behavioural models or studies and therefore decrease the likelihood of using sustainable transport and increase transport modes which are not environmentally friendly.

Previously conducted systematic literature reviews contribute to much what is already known at present. They shed light on cross-disciplinary issues such as criticism of administrative structures between stakeholders, operators and governmental bodies (Hrelja 2019), which approaches are used by local authorities to guide the intervention design and implementation process such as the avoid-shift-implementation approach (A-S-I approach) (Wimbadi 2021), the effectiveness of soft interventions in bringing behavioural change to car-users (Semenescu 2020), how operator's service quality and quality by travellers perceived are capable of increasing the ridership and cause less car addiction (Chowdhury 2016, Redman 2013), the adoption of micro-mobility vehicles as a gap-closer to increase the likelihood of public transport usage (Oeschger 2020), co-benefits of public transport and how commuter's driving habits are able to cause high greenhouse gas emissions (Kwan 2016).

Many scholars have analysed a vast amount of a diverse body of research problems, but to the extent of the conducted literature review none of them took a step back and stopped introducing or improving new interventions in order to investigate the degree of success of interventions. This systematic literature review fills the gap by raising questions such as whether success is measured when it comes to interventions and, in case success is measured, how success is going to be measured, is it methodological sound and which success factors for interventions can be obtained. Beside determining interventions' success factors the systematic literature review will also summarize literature on car-related behavioural models to enhance the understanding of individual's car-use.

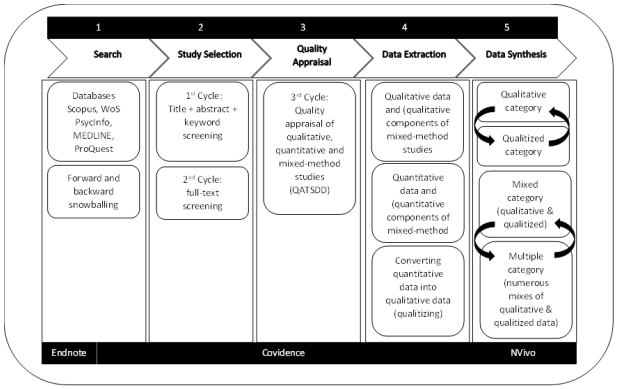

Fig. 1 The convergent integrated approach to MMSR by Stern et al. (Stern 2020)

Methods

This systematic review protocol was developed following the Joanna Briggs Institute (JBI)'s guidance on setting up a mixed-method review protocol (Chapter 8) published in the JBI manual for evidence synthesis (Lizarondo 2020) and is reported in accordance to the updated Preferred Reporting Items for Systematic Reviews and Meta-Analysis Protocols (PRISMA-P) 2015 checklist (Moher 2015) and PRISMA 2015 explanation and elaboration guidelines (Shamseer 2015).

Eligibility criteria

This systematic review is using the PICo (Population, phenomenon of Interest, Context) mnemonic recommended by the JBI manual for a convergent integrated approach. Because quantitative data will be qualitised (transformed into textual descriptions) a mnemonic suited to a quantitative approach is not required. Therefore, studies will be screened based on the following inclusion criteria: population, phenomenon of interest, context and study type.

Population

As the proposed systematic review will examine research on reducing carbon emissions, we will consider all studies where the number of people not using sustainable transport could be minimised by interventions that have been successfully introduced or applied. Of particular interest are studies that report a modal shift from car users or other CO2-emitting vehicles to less CO2-intensive modes of transport, especially if car users or vehicle users were exposed to a transport intervention over time.

Phenomenon of interest

We will consider studies for inclusion which (i) comprise interventions to the adoption of low-carbon transport modes in order to discourage car use / reduce car-dependency or any further interventions aiming at reducing car use / reduce car-dependency

(ii) determining or measuring interventions' effectiveness

(iii) report on a modal shift from car-users or cars to less CO_2 ways of transport

(iv) posit behavioral models to car use versus the use of other types of transport and identify psychosocial barriers or drivers to car use

Context

For inclusion in this review, we will consider studies regardless of their travel settings passengers, travel purpose (e.g., travelling commuting to work, leisure time), travel time, mode of travel (e.g., road traffic, railway, sea or air traffic), geographic locations (e.g., Europe, Asia Pacific, Africa, Australia, North America, South America, Antarctica) as long as studies are applicable to densely populated areas (e.g., municipalities, megacities, urban areas).

Type of study

A systematic literature review is supposed to be an unbiased and replicable representation of current knowledge […] (Sayers 2007). In order to guide the search in an unbiased way and to limit the amount of missed research findings there will neither be any restrictions to particular qualitative study designs nor to quantitative study designs. Both studies with qualitative and quantitative data will be included. Qualitative components and quantitative components of mixed-method studies will also be included. This review will be limited to studies within peer-reviewed journals published in 1990 onwards as 1990 is the international basis year for greenhouse gas emissions. At present all emissions volumes and greenhouse gas emission reduction-progresses will be compared to the baseline of the basis year. All papers in non-English language will be identified and documented. Only full-text papers written in English will be considered for inclusion due to the lack of time, resources and facilities for translation. Thus, the systematic review might be vulnerable to language bias. Is the full text neither available through the services provided by Teesside University's facilities nor through Google Scholar then an interlibrary loan request will be made. After that, any studies that cannot be accessed will be excluded. Duplicates will be technically removed by using Endnote and the upload function in Covidence.

Search strategy

The initial search is matching search terms to each the title, abstract or keywords of a journal article. Hence, the search results are limited to journal articles which explicitly mention the search terms or one of its synonyms in the title, abstract or keyword section. As the review question is a meaningful part of the whole systematic literature review process, the search terms have been derived by the review question.

Review question: Which interventions have been designed to encourage car-users to a frequent usage of sustainable modes of transport? To guide the review-question the Population, Interest Context (PICo)

framework has been applied in order to fulfil the needs of a mixed-method systematic review (MMSRs) (Stern 2020).

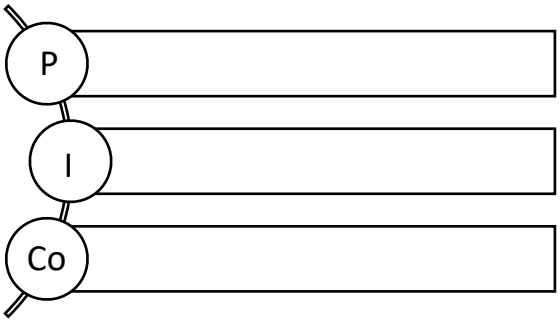

Fig. 2 PICo framework

By breaking the review question down into its underlying components, for instance population, interest and context, keywords for each component have been identified. Then a table of synonyms have been created found in the supplementary material, to enhance the extent of the search and to increase the likelihood of not missing any relevant paper in order to answer the review question (Butler 2016). Thus, truncation indicators (#$+), wild card indicators (*?) and BOOLEAN operators (OR, AND) have been used to, first, create a search string and to , second, increase its sensitivity and specificity.

> TITLE-ABS-KEY ((“public transport*” OR “mass trans*” OR “sustainab* trans*” OR transport* OR mobility OR bus* OR train+ OR subway OR railway OR vehicle+ OR commut* OR “non-car*” OR car*) AND (theor* OR model* OR concept* OR framework# OR behavio#r*) AND (interven* OR “hard interven*” OR “soft interven*” OR meas* OR modal OR “modal shift” OR “modal split” OR “modal change” OR chang* OR pathway+ OR shift) AND (barrier+ OR “social factor+” OR “psychological factor+” OR “structural barrier+” OR “institutional factor+” OR psycho* OR social*) AND (enable* OR facilitat* OR driver+ OR nudg*) AND (cit* OR urb* OR metrop* OR “mega cit*” OR “capital cit*”))

The search strings have been customised for each of the databases Scopus, Web of Science, MEDLINE (PubMed), APA PsycInfo, ProQuest. The customised search strings can also be found in the supplementary material.

The outlined search strategy was developed by the first author (PE) and was peer-reviewed by a librarian working Teesside University library after consultation, who was external to the project.

Once retrieved papers have been identified, the final included papers which will have successfully gone through all three cycles of the selection process will form the basis for identifying additional papers through the processes of forward search and backward search.

In this context, backward search means using the reference list to identify new papers while forward search refers to identifying new papers based on citing the paper being currently examined.

Study records

All literature search results will be uploaded to and stored in Endnote20 (© 2022 Clarivate, United States, www.endnote.com) and will be directly forwarded to the systematic reviewing software Covidence (© 2022 Veritas Health Innovation Ltd, Australia; www.covidence.org). Covidence enables the authors to work simultaneously together by blind voting. Blind voting means that two reviewers vote independently on each study with pressing either the yes, no or maybe buttons before the reference can be technically proceeded. In case of two matching yes-votes the references will be either forwarded to the full text review in Cycle 1 or quality appraisal stage in Cycle 2. In case of two matching no-votes the reference will be sorted to irrelevant references and therefore excluded. In case of disagreement which is a mismatch the references will be sorted to a list called ‘resolve conflicts list’.

The whole selection process will consist of three cycles: Cycle 1: title, abstract and keywords screening, Cycle 2: full-text screening and Cycle 3: quality appraisal. The leading reviewer is PE and the second reviewer is (SP). If consensus need to be reached, a third-party member (TC or PvS) will become the mediator. TC will be the mediator for qualitative research as well as mixed-method research with a leading qualitative element and PvS for quantitative research and mixed-method research with a leading quantitative element.

Selection process

Cycle 1 – Screening Abstract, title and keywords

First, title, keywords and abstract are screened under the consideration of predefined inclusion and exclusion criteria outlined in the previous section Eligibility criteria. Based on the application of the criteria to each article, the first author (PE) will make an individual decision about its inclusion or exclusion. Ten per cent of all decisions made by the leading reviewer will undergo a critical review process by (SP).

In case of agreement the reference will move to Cycle 2 – full-text screening.

In case of disagreement the consensus on which paper will be considered or withdrawn is achieved by full-text screening. Those papers are listed in the resolve conflicts section in Covidence. When the first author (PE) and the second author (SP) after a verbal or written discussion still disagree, the case will be referred to a third researcher (TC or PvS, as explained before) whose final decision to make.

Can a decision not be made due to the lack of missing information a request for information process will be initiated. The first author (PE) contacts the author of an article to obtain relevant information for inclusion or exclusion. Any request which is either not answered properly or within four weeks will not be considered in the systematic literature review process.

The interrater reliability will be assessed by using Cohen's Kappa statistics throughout the whole screening phase. The Cohens Kappa will be calculated through Covidence, or in case Covidence is unavailable due to technical issues via R.

Cycle 2 – Screening full text

Second, the first author (PE) screens the full-text of each paper which passed Cycle 1. SP screens a sample of 10%. In case of agreement the reference will move to the third cycle. But in case of disagreement a discussion between the first author (PE) and the second author (SP) is required. Discussions can either held in an oral or written format as Covidence allows to record and comment produced outcomes. Will the discussion not solve the problem, a third researcher (TC) will be consulted. The first author (PE) attempts to contact the paper's author for clarification if insufficient information is provided and a decision cannot be made. Enquiries should be answered within four weeks after sending the request. Papers with enquiries which remain unanswered will be excluded.

Cycle 3 - Risk of bias individual studies (quality appraisal)

Third, each paper which went through Cycle One and Cycle Two without being excluded will be quality appraised.

In this systematic review, the Quality Assessment Tool for Studies with Divers Designs (QATSDD) developed by Sirriyeh (Sirriyeh 2012) will be used to assess the quality of diverse study designs, including studies with qualitative and quantitative designs.

The QATSDD is a single instrument that allows to quality-appraise studies having rather one instead of two different tools (checklists). The QATSDD-tool consists overall of 16 criteria from which 14 of the 16 criteria are applicable to qualitative studies and 14 to quantitative studies. All 16 criteria are applicable to mixed-method studies. Each of the reviewers assign a quality score on a 4-point scale (0-3) for each criterion independently to a single study. Assuming that each criterion can be given a score from 0 to 3 and each study are rated by at least 14 criteria both qualitative and quantitative studies can be evaluated, according to three bands, on the total score each study has been awarded with:

low-quality studies: 0-14

moderate-quality studies: 15 – 28

high-quality studies: 29 - 42

In the case of a mixed-method study vice versa.

low-quality studies: 0-16

moderate-quality studies: 17 – 32

high-quality studies: 33 - 48

All studies with low quality will be not likely to pass and therefore will be excluded. Papers using either a qualitative or a quantitative approach will be included with a total quality score from 15 onwards while mixed-method studies will be included when the total quality score exceeds the 16 mark.

In case of disagreement between the first and the second reviewer (PE, SP) disagreements can be solved by applying the rules the reviewers agreed on:

In case of a 1-point difference between the total quality score of the first and the second reviewer (PE, SP) the lowest of the two quality scores will be considered without discussion. However, for each total score which exceeds the one-point mark a discussion is required. If the discrepancy cannot be solved through discussion a third reviewer (TC or PvS, as explained before) will be consulted for arbitration.

The Joanna Briggs Institute Critical Appraisal Checklists for Cross-Sectional Studies and the Joanna Briggs Institute Critical Appraisal Checklists for Qualitative Research for Qualitative Studies will not be used.

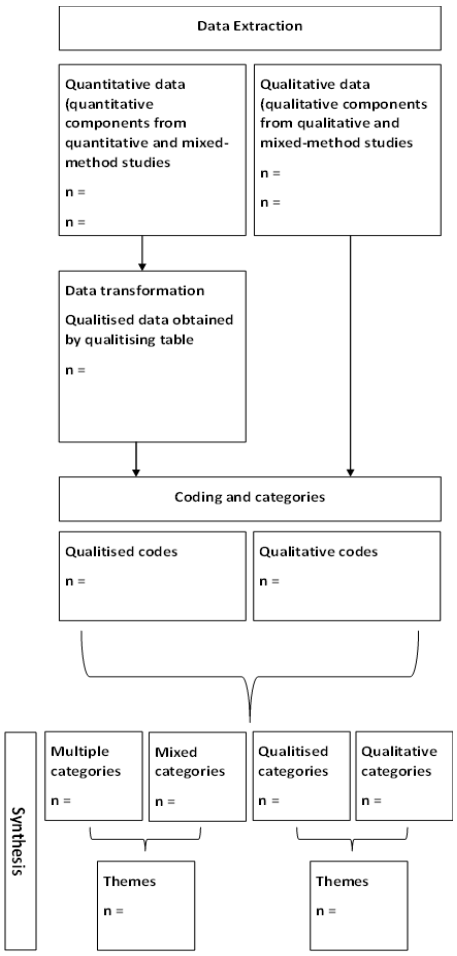

Fig 4 Planned procedures (example) using JBI's convergent integrated approach

Data extraction and Data items

The data corpus will be formed by all included studies which will be rated as high-quality studies passing the third and final cycle. Therefore, categories, themes, illustration and/or verbatim extracts will be sought out of the data corpus' qualitative and mixed-method studies (qualitative components only) by using the data extraction form derived by the JBI mixed-methods data extraction form (Aromataris 2020) in the supplementary material. As it is usually hard to say what counts as data or findings when it comes to qualitative research the planned systematic review will extract key concepts, where appropriate. Hence, the paper's understanding of key concepts is in line with (Thomas and Harden, 2008) who suggest to extract qualitative data of included studies' result section or at least extract written pieces which are labelled as findings or results within a paper for at least one reason (1) preventing potentially systematic review results will be influenced by author's misinterpretation bias.

For quantitative components data will be extracted by the data corpus' quantitative and mixed-methods studies (quantitative component only).

Data extraction will be primarily conducted by (PE). Based on the overall amount of included papers (SP) will support the data extraction by a sample of about 10%. Discrepancies will be solved and consensus will be reached through written or verbal discussions or a third reviewer's decision (TC), if needed. How the systematic review will cope with missing or unclear data are outlined in the section Selection process.

Data Transformation

In the planned systematic review transformation of quantitative data can be described as the process of converting quantitative findings into a qualitative shape ('qualitising') as to respond directly to the review question. This involves transforming numerical data into textual content or a narrative interpretation of quantitative results. This will be done by using a thematic-analysis approach. PE will familiarize himself with all quantitative data extracted in accordance to the review question. This will be accomplished by reading and re-reading all quantitative data in the first instance. In a second step the read data will be converted into textual descriptions in a way that the data will answer the review question ('contextualising'). An additionally qualitising table in the supplementary material will be used to support the transformation process. Before entering the synthesis-stage PE and SP will have a discussion until consensus on the textual descriptions is reached.

Data synthesis

The data synthesis will be carried out by PE using the JBI's convergent integrated approach (Sandelowski 2006, Stern 2020). For data synthesis the software NVivo 12 (© 2022 QSR International Australia www.qsrinternational.com/nvivo-qualitative-data-analysis-software) will be used. So, all data extracted will be transferred from Covidence to NVivo 12 software.

The convergent integrated approach is similar to the approach of a thematic analysis but differs in particular ways: While a thematic analysis assembles and categorize only qualitative data, the convergent integrated approach will attempt to go beyond that limitation by simultaneously merging qualitative and qualitised data together.

The thematic analysis will be outlined in a three-step procedure (1) familiarize with data (2) coding and developing method-based categories (3) developing themes by collapsing categories created under (2).

First step: Familiarize with Data

Prior to identifying themes and conducting a thematic analysis reading the data in an active way usually through reading and re-reading is required. First quantitative data will be read and re-read by PE to get an overview about the depth and breadth of the data. Because the term 'integration' means to combine qualitative with quantitative data, this can only be achieved by qualitising, see section Data Transformation. Hence, qualitised data in form of textual description can then be combined with qualitative data.

Second step: Coding and developing method-based categories

Once all quantitative data will be qualitised into textual descriptions code to each of those textual description will be inductively applied by PE using free line-by-line coding.

Prior to further synthesis of themes PE will code each line of text according to extracted qualitative data.

Until this stage it will be expected that a long list of codes will be added to our bank of codes in NVivo 12 software. Both qualitative and qualitised data with several codes tagged will be categorised and form the basis for quality, qualitised or mixed categories.

Third step: Developing themes by collapsing qualitative and qualitised categories

Thirdly qualitative categories, qualitised categories and mixed-categories will be merged together related to an approach which is similar to 'axial coding' by Strauss. So, the process of synthesising integrated findings involves sorting categories to potential themes. Throughout the process PE will look for similarities and differences of categories and codes in order to be able to sort the different codes into potentially (sub)themes and bringing them into a hierarchically order.

Codes which will not be grouped or synthesized to a theme will be reported as a narrative according to the JBI Manual for Evidence Synthesis.

Discussion

Since much is known about why people use car instead of using low-carbon emission modes of transport in a behavioural context to the extent of the conducted literature review there has not been any mixed-method systematic review conducted so far focussing on the success factors of sustainable transport interventions. So, this MMSR is necessary to add more evidence to the current body of literature in the field of transport intervention and car-use reduction. The review has the potential to inform governmental bodies, intermediates and operators in the light of carbon Dioxide reduction about highly-recommended intervention choices, occurring obstacles and in providing an overview of whether and how interventions' progress can be determined and tracked.

In understanding car-usage behaviour authorities, intermediates and operators will be enabled to rethink ongoing concepts or campaigns. They will be sensitised to consider reported results in their intervention design process. Further public and private services can be optimised to increase the likelihood of a modal shift from car-users to sustainable modes of transport.

Besides that, the proposed systematic review contributes to methodological aspects. This systematic review will demonstrate how methodological techniques borrowed from the medical and health sector can be applied to other disciplines such as social science. At present there only has been a limited number of papers published using the JBI's convergent integrated approach in any discipline. In planning, conducting and publishing the systematic review project one out of few studies will be added to contribute to the literature by providing a clear understanding of which procedures used lead to better outcomes in conducting a convergent integrated approach.

The review has the potential to reveal patterns among countries with low CO_2 emissions to road-traffic and car-usage which may explain what other countries already have done and Germany should do to actively reduce Germany's car induced high carbon dioxide emission

Ethics and dissemination

For the proposed systematic literature review ethical approval is not required as the systematic literature review itself is a desk-based study and any primary data

will not be gathered. Findings of the systematic review will be disseminated by publishing the systematic review in an international peer-reviewed journal.

References

AROMATARIS, E. & MUNN, Z. 2020. Appendix 8.1 JBI Mixed Methods Data Extraction Form following a Convergent Integrated Approach. *JBI Manual for Evidence Synthesis.*

BUTLER, A., HALL, H. & COPNELL, B. 2016. A Guide to Writing a Qualitative Systematic Review Protocol to Enhance Evidence-Based Practice in Nursing and Health Care. *Worldviews Evid Based Nurs,* 13**,** 241-9.

CHNG, S., ABRAHAM, C., WHITE, M. P., HOFFMANN, C. & SKIPPON, S. 2018. Psychological theories of car use: An integrative review and conceptual framework. *Journal of Environmental Psychology,* 55**,** 23-33.

CHOWDHURY, S. & CEDER, A. 2016. Users' willingness to ride an integrated public-transport service: A literature review. *Transport Policy,* 48**,** 183-195.

COMMISSION, E., MOBILITY, D.-G. F. & TRANSPORT 2022. *EU transport in figures : statistical pocketbook 2022*, Publications Office of the European Union.

HRELJA, R., KHAN, J. & PETTERSSON, F. 2019. How to create efficient public transport systems? A systematic review of critical problems and approaches for addressing the problems. *Transport Policy,* 98**,** 186-196.

HUNECKE, M., RICHTER, N. & HEPPNER, H. 2021. Autonomy loss, privacy invasion and data misuse as psychological barriers to peer-to-peer collaborative car use. *Transportation Research Interdisciplinary Perspectives,* 10**,** 100403.

KWAN, S. C. & HASHIM, J. H. 2016. A review on co-benefits of mass public transportation in climate change mitigation. *Sustainable Cities and Society,* 22**,** 11-18.

LIZARONDO, L., STERN C, CARRIER J, GODFREY C, RIEGER K, SALMOND S, APOSTOLO J, KIRKPATRICK P, LOVEDAY H. 2020. Chapter 8: Mixed methods systematic reviews. *In:* AROMATARIS E, M. Z. (ed.) *JBI Manual for Evidence Synthesis.*

LORENZONI, I., NICHOLSON-COLE, S. & WHITMARSH, L. 2007. Barriers perceived to engaging with climate change among the UK public and their policy implications. *Global Environmental Change,* 17**,** 445-459.

MOHER, D., SHAMSEER, L., CLARKE, M., GHERSI, D., LIBERATI, A., PETTICREW, M., SHEKELLE, P., STEWART, L. A. & GROUP, P.-P. 2015. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Systematic Reviews,* 4**,** 1.

OESCHGER, G., CARROLL, P. & CAULFIELD, B. 2020. Micromobility and public transport integration: The current state of knowledge. *Transportation Research Part D: Transport and Environment,* 89**,** 102628.

PRONELLO, C. & GABORIEAU, J.-B. 2018. Engaging in Pro-Environment Travel Behaviour Research from a Psycho-Social Perspective: A Review of Behavioural Variables and Theories. *Sustainability,* 10**,** 2412.

REDMAN, L., FRIMAN, M., GÄRLING, T. & HARTIG, T. 2013. Quality attributes of public transport that attract car users: A research review. *Transport Policy,* 25**,** 119-127.

SANDELOWSKI, M., VOILS, C. I. & BARROSO, J. 2006. Defining and Designing Mixed Research Synthesis Studies. *Res Sch,* 13**,** 29.

SAYERS, A. 2007. Tips and tricks in performing a systematic review. *Br J Gen Pract,* 57**,** 425.

SEMENESCU, A., GAVRELIUC, A. & SÂRBESCU, P. 2020. 30 Years of soft interventions to reduce car use – A systematic review and meta-analysis. *Transportation Research Part D: Transport and Environment,* 85**,** 102397.

SHAMSEER, L., MOHER, D., CLARKE, M., GHERSI, D., LIBERATI, A., PETTICREW, M., SHEKELLE, P. & STEWART, L. A. 2015. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. *BMJ : British Medical Journal,* 349**,** g7647.

SIRRIYEH, R., LAWTON, R., GARDNER, P. & ARMITAGE, G. 2012. Reviewing studies with diverse designs: the development and evaluation of a new tool. *Journal of Evaluation in Clinical Practice,* 18**,** 746-752.

STEG, L. 2007. SUSTAINABLE TRANSPORTATION: A Psychological Perspective. *IATSS Research,* 31**,** 58-66.

STERN, C., LIZARONDO, L., CARRIER, J., GODFREY, C., RIEGER, K., SALMOND, S., APÓSTOLO, J., KIRKPATRICK, P. & LOVEDAY, H. 2020. Methodological guidance for the conduct of mixed methods systematic reviews. *JBI Evidence Synthesis,* 18**,** 2108-2118.

THOMAS, J. & HARDEN, A. 2008. Methods for the thematic synthesis of qualitative research in systematic reviews. *BMC Medical Research Methodology,* 8**,** 45.

UMWELTBUNDESAMT 2021. National Inventory Report for the German Greenhouse Gas Inventory 1990 – 2019. *Climate Change | 44/2021.* Germany.

UNITED NATIONS CLIMATE CHANGE. Report of the Conference of the Parties on its nineteenth session, held in Warsaw from 11 to 23 November 2013. 2013 Warsaw. 1-54.

WEIAND, L., SCHMITZ, S., BECKER, S., NIEHOFF, N., SCHWARTZBACH, F. & VON SCHNEIDEMESSER, E. 2019. Climate change and air pollution: the connection between traffic intervention policies and public acceptance in a local context. *Environmental Research Letters,* 14**,** 085008.

WIMBADI, R. W., DJALANTE, R. & MORI, A. 2021. Urban experiments with public transport for low carbon mobility transitions in cities: A systematic literature review (1990–2020). *Sustainable Cities and Society,* 72**,** 103023.

WORLD METEOROLOGICAL ORGANIZATION (WMO) 2018. WMO Statement on the state of the global climate in 2017. *WMO -No. 1212.* Geneva (Switzerland).

WORLD METEOROLOGICAL ORGANIZATION (WMO) 2020. WMO Statement on the state of the global climate in 2019. *WMO- No. 1248.* Geneva (Switzerland).