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## Advancing research in transportation and public health: A selection of twenty project ideas from a U.S. research roadmap

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### ABSTRACT

**Background:** Transportation policies and projects have multiple impacts on health. Research on these impacts can help promote positive and reduce adverse health consequences of decisions made by transportation agencies.

**Methods:** In 2019 the U.S. National Cooperative Highway Research Program published a research roadmap for transportation and public health based on an extensive literature search and key informant interviews. The roadmap identified 44 research gaps and 122 research needs on a wide range of relevant topics. From this list, using pre-established criteria including specificity, equity, potential impact, and long-term usefulness, we selected 20 topics suitable for further research especially in academic settings.

**Results:** We present the questions, context, and possible research approach for each of the 20 topics. These topics cover issues ranging from integrating equity into performance measures and developing forecasting models for active travel to incorporating health questions into routine household travel surveys and examining health impacts of autonomous vehicles. We added questions on the impacts of the COVID-19 pandemic on transportation.

**Discussion:** This list will be useful to faculty, researchers, and students as they consider topics for research in transportation and public health. Results of research on these topics could influence transportation decisions in policy making, planning and community participation, capital programming, project design, and implementation. Future leaders of transportation agencies, transportation providers, and advocacy organizations may be more likely to consider transportation policies that incorporate a health perspective if their training includes research findings that increase their awareness of the health impacts of these policies.

## 1. Background

Transportation is an essential component of society, providing individual mobility and access to goods and services as well as

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facilitating economic development. Transportation has multiple impacts on health, including safety, air quality, physical activity, mental health, social capital, and resilience (Litman 2013, Meyer and Elrahman, 2019; Nieuwenhuijsen and Khreis, 2020). Transportation also influences health equity because its impacts are rarely distributed uniformly (Malekafzali 2009; Smart Growth America 2019). Research on the health impacts of transportation policies and projects can help promote the health benefits and reduce adverse health impacts of decisions made by transportation agencies. For example, research results can guide transportation agency decision-making and foster community participation to advocate for or express concern about specific health impacts.

The development of a research roadmap is a useful step in moving a growing field forward. A research roadmap can synthesize contributions to date, identify new and emerging themes, and recognize critical gaps that deserve future research attention. It provides strategic direction to the broader community of researchers while explicitly calling out opportunities where additional research attention can be most productive. For example, the 2003 research agenda for health and community design has now been cited over 450 times (Dannenberg 2003).

In 2016, the National Cooperative Highway Research Program (NCHRP) initiated a project to create a research roadmap identifying areas related to transportation and public health that would be useful to state departments of transportation (DOTs) and other transportation agencies and organizations. Because in the United States oversight of transportation policies, plans, and projects is complex and occurs at the federal, state, regional, and city levels, some research topics may be of more interest to state transportation agencies than others. The NCHRP is designed to support research on topics of practical use to state DOTs in the United States (<http://www.trb.org/NCHRP/NCHRPOverview.aspx>). Generally state transportation agencies are more interested in research projects whose results are within their purview to implement or manage and could be applied in the short to medium term, while academic researchers in transportation and health may be more likely to focus on projects that lead to better population health in the medium to long term.

The NCHRP project funding was awarded competitively to a research team at the University of North Carolina at Chapel Hill. The final report released in 2019 included a 64-page research roadmap monograph (National Academies of Sciences Engineering and Medicine (NASEM), 2019, <http://www.trb.org/Publications/Blurbs/179959.aspx>) and a 90-page supplementary report describing the background, methods, and references for the project (Sandt 2019). The database of resources referenced in the report is available at [http://pedbikeinfo.org/resources/resources\\_details.cfm?id=5214](http://pedbikeinfo.org/resources/resources_details.cfm?id=5214).

The NCHRP Research Roadmap report identifies 44 research gaps and highlights 122 related research needs that are primarily oriented to advancing the work of state DOTs in integrating health considerations into transportation policies and projects. The Roadmap describes a research gap as a larger topic about which little is known, and a research need as a more specific question related to a gap that could be developed into a potentially fundable research proposal. The Research Roadmap report includes a wealth of ideas that could inform faculty, researchers, and students interested in advancing transportation and public health research at the local, regional, state, and federal levels.

This journal report selects 20 research needs from the NCHRP Research Roadmap report considered as high priority for future academic research. The purpose of this journal report is to disseminate more broadly these 20 priority research needs to move the field forward and help educate the next generation of transportation researchers and leaders.

## 2. Methods

This journal report is adapted from and expands upon portions of the NCHRP Research Report 932, A Research Roadmap for Transportation and Public Health (NASEM 2019). This roadmap focuses on pathways that transportation agencies can use to support health, including improving access to opportunities and services, providing opportunities for physical activity, mitigating human exposure to environmental risks, preventing injuries and improving safety, supporting resiliency in relation to disasters and extreme weather events, and promoting community connectedness and vitality.

NCHRP projects include an oversight panel composed of practitioners and academics, whose role is to provide feedback, guidance, and direction to the project team doing the work. As requested by the oversight panel for this project, the researchers focused on under-researched topics in transportation and public health, rather than on safety and air pollution topics that have been extensively documented in the transportation literature.

The research roadmap team conducted an extensive literature search that identified over 300 sources in the peer-reviewed literature and over 90 sources in the gray literature (such as agency-sponsored reports) related to the role of transportation agencies in health. The research team also conducted 22 semi-structured interviews with transportation and public health stakeholders in federal, state, and local agencies and in private consulting firms. With feedback from the project oversight panel, the research team then synthesized the information collected into the research roadmap monograph (NASEM 2019) that lists 44 research gaps and 122 research needs covering a wide variety of topics. Based on these findings, the research roadmap team also wrote ten formatted "Research Problem Statements" that would be of particular interest to state transportation agencies. Subsequently, the project oversight panel prioritized and promoted some of these problem statements for possible NCHRP funding.

The three authors of this journal report were members of the project team (LS, DR) or oversight panel (AD). Together we reviewed the 122 research needs independently, conducted two rounds of voting to subjectively identify high, medium, and low priority topics, and discussed the results to reach consensus on the most important 32 research needs. After combining and editing these 32 needs, this journal report provides highlights of 20 priority topics suitable for further research.

In voting and discussing the research needs, the three authors agreed to prioritize research needs that (a) incorporate elements explicitly related to health and to transportation, (b) have a specific scope that is feasible as a potentially fundable research project, (c) may lead to impactful results, such as influencing policy at the local, regional, state, or federal level, but not limited to state DOTs, (d) involve processes or results that focus on underserved populations, (e) may lead to results useful as a long term investment, such as

**Table 1**

Twenty selected transportation and health research questions, context, and possible research approaches.

Research question	Context	Possible research approach
<b>MEASURES AND TOOLS</b>		
1. How often are land use, travel pricing, transit, and other Transportation Demand Management (TDM) tools being used as part of transportation policymaking and planning? How can the impacts of such tools be evaluated in relation to health and equity outcomes?	TDM tools include choices about land use, single occupant vehicle use, transit availability, and travel pricing (such as parking, cordon, and congestion pricing). But these choices may have differing or contradictory impacts on health and equity. For example, low-income travelers are less likely to be able afford higher daily travel costs or longer wait times ( <a href="https://equitycaucus.org/">https://equitycaucus.org/</a> ), but the air quality benefits of decreased driving will substantially benefit low income residents (Schweitzer 2008). Revenue provided by congestion pricing could offset the burden to low-income drivers harmed, while roads without congestion pricing still burden low-income drivers and do nothing to mitigate harms (Manville 2017). Transportation agencies frequently have calculators to estimate the travel and air quality impacts of TDM tools. Incorporating health and equity impacts into those calculators appears to be a promising way of integrating these themes into TDM planning. Land use and travel pricing measures may have the most positive effect on public health by reducing the need to travel, enhancing green space, and facilitating use of active modes for traveling shorter distances (Khreis 2017).	Synthesize existing literature and survey transportation agencies regarding their consideration of health in assessing the impacts of TDM tools. Develop and apply methods to connect TDM tools with their possible health and equity impacts.
2. How can federal, state, and local transportation agencies align policy goals with advancing health and equity by shifting from automobile-oriented measures of performance (such as level of service) to measures of performance aligned with health co-benefits (such as reduction in vehicle miles traveled), even if health is not explicitly mentioned as an agency goal? How can the impacts on health of shifting these measures be assessed? How can measures of performance take into account the impacts of pandemics?	Following the maxim “what gets counted, counts,” transportation agencies have long prioritized moving more vehicles faster with a goal of congestion mitigation. Building on the guidance from Malekafzali (2009), travel demand and performance metrics should be more focused on supporting transportation policy goals to promote health and equity and less focused on vehicle-oriented measures of performance. It is unknown how often existing performance measures for walking and bicycling are being used (Federal Highway Administration 2016).	Synthesize existing literature and transportation agency practices related to performance measures. Develop case studies of transportation agencies that have moved to performance measures aligned with health, such as Caltrans in California (Tyner 2019).
3. What practices are used in states to report non-fatal crashes? What recommendations can be developed for collecting nationally comparable data on non-fatal injuries sustained by pedestrians and bicyclists that may or may not involve motor vehicles?	Many roadway improvement projects have been implemented over the years based on police-reported data about types and locations of motor vehicle crashes. Police crash reporting systems were designed to capture crash events involving motor vehicles but often exclude or under-report crashes involving pedestrians and bicyclists, particularly where no motor vehicle was involved (Stutts 1999; Doggett et al, 2018; CDC 2019, Sandt et al., 2020). Better collection of data on non-fatal injuries to pedestrians and bicyclists (as well as fatal injuries not involving motor vehicles) would lead to improved decision-making for those travel modes.	Identify existing nonfatal transportation injury surveillance programs that could be adapted/enhanced or serve as a model for a new injury reporting system, such as the nonfatal injury data available in CDC’s WISQARS reporting system based on emergency room surveillance systems ( <a href="https://www.cdc.gov/injury/wisqars/nonfatal.html">https://www.cdc.gov/injury/wisqars/nonfatal.html</a> ). Alternatively, survey state and metropolitan DOTs to determine how they collect, store, and analyze non-fatal crash data, particularly cases involving pedestrians, bicyclists, and persons using micromobility devices.

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Table 1 (continued)

Research question	Context	Possible research approach
4. What tools exist or could be developed for more robust travel demand modeling and forecasting for estimating pedestrian, bicycle, and transit travel demand in various contexts? How could the impacts of using such tools be assessed?	Travel demand modeling and forecasting is routinely used to guide decisions about building road and transit infrastructure, but few such tools exist for pedestrian and bicycle demand (Aoun et al., 2015). Whether it is the context of a 4-step travel forecasting model (McNally 2007) or an activity-based model (National Academies of Sciences Engineering and Medicine (NASEM), 2019), these improvements could lead to more health-promoting choices in decisions about where and when to build pedestrian and bicycle infrastructure.	Review existing literature to identify gaps and strengths within existing forecasting approaches (4-step models, activity-based models, transit stop-level models, and others) and promising avenues for future research (Singleton 2018). Collaborate with travel demand modeling experts to develop new resources or improve existing tools for modeling pedestrian, bicycle, and transit demand, including the use of active transportation modes for access and egress.
5. What methods can be developed to forecast long-term health impacts of heat island effects and impervious surface-induced local flooding related to land uses devoted to parking, existing and future roads, and other transportation-related infrastructure?	Climate change is expected to have numerous impacts on transportation (National Research Council 2008), many of which affect health and equity. The health impacts of these environmental changes could be better forecasted and mitigated by improvements in methodological approaches to consider heat island effects, local flooding, air quality, and related changes.	Conduct a literature review to identify possible metrics and modeling approaches for heat island impacts and local storm-water flooding related to transportation infrastructure.
6. What existing and emerging technologies (such as mobile device tracking through Bluetooth and global positioning systems) can be used and validated to better measure physical activity and travel behaviors? How can pedestrian and bicycle counts be derived from such technologies? How can such data sources contribute to a health and equity perspective of travel behavior?	Consistent with the concept that better data can lead to better policies, new technologies offer opportunities for more reliable and valid measures of physical activity and active travel behaviors. Current technologies focus on physical activity levels for individuals (e.g., accelerometers) and on frequency of use of specific locations (e.g., trail counters), but these data sources are seldom integrated for use in travel demand modeling.	Identify and validate new measuring technologies in laboratory and in real-world settings. Conduct studies to validate mobile device trackers with calibrated bicycle and pedestrian counters and identify and adjust for sources of bias such as underrepresented groups.
<b>TRANSPORTATION AGENCY PLANNING AND HEALTH PRACTICES</b>		
7. How are communities now funding, using, and maintaining online mapping or data visualization platforms as well as other innovative experiential ways of community involvement (e.g., from temporary pop-ups to virtual reality)? How are new data being integrated into transportation practices and public engagement, especially in relation to health issues? What are the impacts on health of using such tools?	Community engagement is central to promoting health and equity goals in transportation. Many community members encounter significant obstacles when examining proposed transportation projects but can achieve better comprehension and provide more useful feedback when presented with clearer visualizations of the issues and the physical construction involved. Improved ways of involving residents, workers, community groups, and advocacy organizations can result from emerging experiential tools based on new technologies.	Document how various types of data visualization tools are being used in other fields for community engagement. Explore how such tools are being used in transportation, such as in the Vision Zero Program in North Carolina ( <a href="https://ncvisionzero.org/data-analytics/visualizations/">https://ncvisionzero.org/data-analytics/visualizations/</a> ).
8. Which state, metropolitan planning organization (MPO), and city transportation agencies currently integrate health questions into household travel surveys? What questions do they use and have they been evaluated for validity and reliability? How could a bank of such questions be developed to contribute to health by making easier their incorporation into travel surveys? What new survey questions are needed to assess changes in travel behavior associated with pandemic impacts?	Routine inclusion of health and equity questions in household transportation surveys and of transportation questions in health surveys would provide data valuable for advancing the field of transportation and health. This work could build upon prior efforts to create an archive of household travel surveys ( <a href="http://www.surveyarchive.org/">http://www.surveyarchive.org/</a> ).	Identify health questions in existing travel surveys and create an online databank of questions. Assess validity and reliability of questions in pilot tests. Examine results of such questions across multiple travel surveys.

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Table 1 (continued)

Research question	Context	Possible research approach
9. Which MPOs and state DOTs now include explicit health indicators in their transportation project prioritization criteria? How were these indicators selected? Are other MPOs and state DOTs interested in incorporating health into project prioritization and programming decisions, and what challenges do they face to do so? How have these health indicators influenced agency decisions? What factors influence whether an agency chooses to incorporate such health indicators in its prioritization process?	Indicators are often used in setting transportation project priorities, such as level of service for automobiles. Developing and using indicators explicitly focused on the health and equity aspects of transportation projects, such as walkability, permits transportation planners to better consider health in their decisions (Feizi 2020; Meehan 2017).	Document case studies of where MPOs and other agencies have incorporated explicit health indicators into their transportation project prioritization processes. Survey transportation agencies for their interest in using such indicators.
10. Which transportation agencies now collect and review health data for potential impacts as part of their screening of proposed transportation projects? What methods and data sources are used now and what new methods and data sources are needed to expand the incorporation of health into the screening process for transportation projects? How have these health data influenced agency decisions? What factors influence whether or not an agency chooses to incorporate such health data in its screening process?	Because agencies have finite resources, potential transportation projects must pass initial screening to be considered for possible funding. Incorporating health-related data such as obesity rates, air quality, injuries, and access to transit, parks, and healthy food into this screening process may lead to healthier choices of proposed transportation projects. Transportation planners may not have ready access to such data, or it may not be available for the specific geographic locations or at the scale where it is needed.	Conduct a survey of transportation agencies to assess which types of health data they now consider in their screening of proposed transportation projects and which additional methods and health data would be desirable.
11. What rigorous economic evaluations have been done to assess the short-term and long-term health impacts of transportation capital projects and programs? What data and new methods are needed for such economic evaluations? How do changes in shared modes to reduce infectious disease transmission affect these results?	Cost-benefit and cost-effectiveness analyses are often used as part of priority setting for transportation capital projects and programs. To incorporate health impacts, such economic analyses need to estimate health care costs and the monetary value of a human life or identify appropriate alternatives. A few such analyses have been published (Gotschi 2011; Gu 2017), but there remains a need for more robust measures and consistent guidance or standards for incorporating health impacts into evaluations.	Conduct literature searches on types of cost-benefit and cost-effectiveness analyses now performed for transportation projects and on similar analyses involving health impacts in other sectors, such as energy and housing. Conduct an economic evaluation from a health perspective to compare an investment in a large-scale transit project to a similar investment in a large-scale highway project.
12. What metrics and models can be further developed to evaluate how health-supportive transportation policies, such as Complete Streets and Safe Routes to Schools, change transportation decisions and outcomes and improve health and equity?	Policies such as Complete Streets and Safe Routes to Schools are often promoted as beneficial to health. Formal evaluations of such policies in multiple communities would help strengthen the evidence to consider the health and equity impacts of such policies (Porter 2018). Ricklin and Shah (2017) describes policies to support health across various domains (including active living, healthy food systems, environmental exposures, emergency preparedness, and social cohesion) and guidance on how to measure performance of plans and policies in these areas.	Build on the literature identified in the Research Roadmap Final Report (Sandt 2019) to assess which health outcomes have been studied for health promoting transportation policies such as Complete Streets and Safe Routes to Schools, what are the estimated impacts, who is impacted, and the methodology used to ascertain impacts.

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Table 1 (continued)

Research question	Context	Possible research approach
<b>TRANSIT AND HEALTH</b>		
13. What are the overall and potential benefits of transit use on specific attributes of health such as health equity, social cohesion, air quality, road safety, pollutants, physical activity, disability access, and well-being? How can these findings be combined to show system level benefits on multiple health domains? When transit users are concerned about infectious disease transmission, what are the net health benefits of transit use compared with other modes?	Public transit use is often promoted for its economic and safety benefits and relatively infrequently for its health benefits such as walking (Le 2020). Approaches that document both individual and combined health benefits of transit may help attract more resources for building and operating transit systems. The reduction in transit use during the COVID-19 pandemic is a threat to the continued operations and development of transit systems.	Conduct a literature search to assess which health attributes of transit have been examined in existing studies. Develop methods to combine multiple health benefits. Explore the health implications of reduced transit use during the pandemic.
14. How can the health benefits of transit implementation be quantified and translated into metrics for health outcome improvements and health care cost savings? How do pandemic concerns affect these health benefits?	Because economic analyses are often a factor in transportation project decisions, improved metrics for health outcome improvements and health care cost savings can help incorporate health issues into decisions about developing and operating transit systems.	Examine metrics used in other types of health outcome studies and adapt these metrics for use in quantifying the health benefits of transit.
<b>INTERDISCIPLINARY TRAINING AND COLLABORATION</b>		
15. What are examples of transportation and health interagency collaboration to advance health in transportation processes and practices in urban and rural settings? What are examples of “bridge” staff being hired or loaned between transportation and health agencies to help develop cross-sector collaboration tools, training, and capacity? How have transportation agencies acquired access to public health expertise for pandemic response?	Health can be promoted in transportation agencies by identifying collaborative processes and practices such as data sharing and usage agreements, memoranda of understanding, executive and legislative approaches, and use of community health assessments. Such collaborative practices may be accelerated when staff are shared across departments and contribute toward building a common language and identifying shared goals and interests.	Document case studies of settings in which transportation and public health agencies have worked together in urban and rural contexts and with different subpopulations, especially where they have shared staff. Identify funding mechanisms and other organizational practices supportive of sustainable collaboration and shared/bridge staffing approaches. Document collaboration between transportation and public health agencies during the COVID-19 pandemic.
16. What are current practices in offering public health training opportunities for transportation planners, designers, and engineers? What course learning objectives and model curricula would be most effective for improving workforce knowledge and skills in transportation and health issues, including pandemic response? What public health related content could be added to existing training courses? How does providing public health training to transportation agency staff impact their subsequent decisions?	Some transportation professionals consider safety and air quality as the only important impacts of transportation on health. Health may be improved if all transportation practitioners had more knowledge of the range of impacts on health of the decisions they make and if they would self-identify as public health influencers. Having a better understanding of current training can facilitate improved training in transportation and health for practitioners.	Develop and disseminate model curricula to teach public health concepts to transportation planners and engineers, using existing or new course materials and learning objectives (Botchwey 2009, <a href="http://bephc.gatech.edu">http://bephc.gatech.edu</a> ).
<b>DISASTER PLANNING AND RECOVERY</b>		
17. How can policies designed to support transportation systems that are resilient to disasters incorporate adaptation and mitigation for the short-term and long-term health effects of hurricanes, flooding, drought, temperature extremes, urban heat island, and pandemics? What are the health implications for disaster planning and recovery of emerging technologies such as micromobility and autonomous vehicles?	Planning to develop resilient transportation systems is especially important as the impacts of climate change increase in coming decades. New technologies such as autonomous vehicles that rely on roadside and satellite communications infrastructure may cease working if technology, communication, or supply chain systems fail during a disaster.	Conduct case studies of how newer transportation system technologies have performed or been affected in recent disasters. Analyze disaster preparedness plans for potential resilience. Create scenarios of how emerging technologies may function in disaster settings. Examine options to enhance resiliency or redundancy, such as having shared bicycles default to an unlocked position when cell phone signals fail.

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Table 1 (continued)

Research question	Context	Possible research approach
18. What are the challenges, opportunities, and best practices for leveraging recovery funds to integrate health considerations into new transportation investments after a disaster? What are the optimal uses of post-pandemic recovery funds to maintain the operations of public transit systems that experienced major ridership losses?	Post-disaster recovery funds are often used to rebuild infrastructure similar to that which existed prior to the disaster; such funds may be subject to restrictions that limit introduction of innovations. Identifying case studies of using such funds to incorporate health considerations into transportation investments would be valuable.	Document case studies where recovery funds have incorporated health considerations into rebuilding efforts. Explore possibilities such as designing bicycle trails outside of floodplains to serve as flood evacuation routes and redesigning transit systems to reduce infectious disease risks.
<b>EMERGING TECHNOLOGIES</b>		
19. How are specific populations using emerging micromobility modes, especially bicycle sharing and scooters? What are the health and equity impacts of using these forms of mobility and from policies related to these technologies? In what ways do these policies increase or reduce disparities among various sub-populations? How do concerns about disease transmission influence the willingness of users to share micromobility modes?	The introduction of micromobility options in the United States and elsewhere is leading to more transportation choices for various specific populations. But these options have the potential for unintended consequences because most existing transportation infrastructure (such as sidewalks) is not designed to accommodate small motorized vehicles. Issues for research include equity, physical activity levels, mode substitution, safety, car-sharing, access for persons with disabilities, and environmental impacts.	Analyze available travel and safety data from current micromobility programs in different contexts. Identify existing and needed sources of health data and methods to assess access, equity, and other program impacts. Examine the strengths and limitations in micromobility programs that serve persons with disabilities and document case studies of best practices ( <a href="https://www.tcacycling.org/">https://www.tcacycling.org/</a> ).
20. What are the estimated changes in sedentary behaviors and concomitant health and equity outcomes that may result from the predicted widespread use of autonomous vehicles? How do concerns about disease transmission influence the willingness of users to share autonomous vehicles?	At least four reviews have been published describing the predicted impacts of autonomous vehicles on public health (Crayton 2017; Dean 2019; Rojas-Rueda et al., 2020; Spence et al., 2020). Numerous research opportunities exist to document the actual impacts of these vehicles on health as their use becomes more widespread and to inform future policy choices that will guide such use.	Use existing published reviews to guide modeling of potential health outcomes of autonomous vehicles. Examine case studies in settings where autonomous vehicles have been introduced.

Source: NCHRP Research Report # 932: A Research Roadmap for Transportation and Public Health. 2019.

development of a new decision-support tool that incorporates health into a project prioritization process, (f) may lead to results that transform practice, methods, technology, or policy, and (g) focus on multiple health outcomes and travel modes.

After the NCHRP Research Roadmap was published in 2019, the COVID-19 pandemic began and quickly influenced the operations and frequency of use of various transportation modes including automobiles, public transit, airplanes, shared micromobility systems, bicycling, and walking. We edited some of the research needs described in Table 1 to incorporate new transportation research implications associated with the pandemic.

### 3. Results

The 20 topics selected cover a variety of issues ranging from integrating equity into performance measures and developing forecasting models for active travel to incorporating health questions into travel surveys and examining health impacts of autonomous vehicles. These topics could influence aspects of transportation including policy making, planning and community participation, capital programming, project design, and implementation.

Table 1 presents the 20 research topics and the context in which the topic may be explored. Table 1 also lists one of several possible research approaches that might be considered to address each of the topics. Table 2 summarizes the characteristics of these 20 research topics such as modes and health impacts under study, suggested research approach, suitability of topic as a graduate student thesis or capstone project, and whether the aspects of the topic may be influenced by the pandemic.

### 4. Discussion

The NCHRP Research Roadmap incorporated the results of a broad scan of research gaps related to health and transportation, based on both published literature and informant interviews. Using specific criteria for prioritization, the 20 topics described in this journal report were selected from the Roadmap for their value in moving forward the field of transportation and public health research. It is hoped that this list will be especially useful to faculty, researchers, and students who select areas in which to conduct short or long-term research projects. Some of the topics in the list are relatively broad and could be broken into multiple specific topics on which more detailed analyses or literature reviews could be conducted.

Future leaders of transportation agencies, transportation providers, advocacy organizations, and community groups may be more

**Table 2**  
Characteristics of the 20 selected transportation and public health research questions.

Category <sup>b</sup>	Research topic <sup>a</sup>	Area of research emphasis				Mode under study				Type of health impact				Research type				Resources needed		Pandemic related
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	
1.	Transportation Demand Management tools for health and equity outcomes	x		x					x		x	x	x	x		x		x		
2.	Aligning measures of performance with health co-benefits	x		x				x	x			x	x	x	x	x		x	x	
3.	Reporting non-fatal crashes sustained by pedestrians and bicyclists			x		x		x			x			x	x		x		x	
4.	Modeling and forecasting for pedestrian, bicycle, and transit travel demand	x		x		x	x			x				x			x		x	
5.	Modeling of health impacts of heat island effects	x		x				x				x	x			x		x		
6.	Validating measures of physical activity and travel behaviors			x	x	x				x		x		x			x	x		
7.	Online mapping or data visualization platforms for community engagement	x		x	x			x			x	x	x	x	x	x		x		
8.	Integrating health questions into travel surveys	x		x				x				x	x	x		x	x		x	
9.	Health indicators in transportation project prioritization criteria	x		x				x				x		x	x		x			
10.	Health data for screening of proposed transportation projects	x		x				x				x		x		x	x			
11.	Economic evaluations of transportation capital projects and programs	x		x				x				x	x	x	x		x		x	
12.	Metrics to evaluate health-oriented transportation policies	x		x				x				x	x	x		x	x			
13.	Benefits of transit use on specific attributes of health	x		x				x		x	x	x		x		x	x		x	
14.	Quantifying health benefits of transit	x		x				x				x	x			x	x		x	
15.	Interagency collaboration and use of "bridge" staff	x	x					x				x		x	x		x		x	
16.	Public health training opportunities for transportation planners	x	x					x				x		x	x		x		x	
17.	Transportation systems resilient to disasters	x			x			x				x	x	x	x		x		x	
18.	Leveraging recovery funds to integrate health considerations	x						x				x	x	x	x		x		x	
19.	Use of emerging micromobility modes			x	x	x						x	x	x		x		x	x	
20.	Health impacts of autonomous vehicle			x	x			x				x	x	x		x		x	x	

Source: NCHRP Research Report # 932: A Research Roadmap for Transportation and Public Health. 2019.

<sup>a</sup> Research topics correspond to questions in Table 1.

<sup>b</sup> Categories: I. Area of research emphasis - A. Agency planning and processes; B. Communication and education; C. Methods and measurement; D. New technologies. II. Mode under study - E. Active travel; F. Transit; G. Motor vehicles; H. All modes. III. Type of health impact - I. Physical activity; J. Injury; K. Equity for vulnerable populations; L. Multiple health impacts. IV. Research type - M. Literature review; N. Survey of transportation agencies; O. Case studies; P. Develop new tools. V. Time and resources needed - Q. Possible graduate student thesis; R. Requires substantial external funding.

likely to develop transportation policies that incorporate a health perspective if their training provides a high level of awareness of the health impacts of transportation decisions. That awareness is enhanced when students participate in transportation and health research projects during their training as a thesis or capstone project or as a research assistant to a faculty mentor.

The NCHRP Research Roadmap report and supporting documents referenced at least 39 studies related to transportation and health equity (such as [Jeekel 2017](#); [Litman 2020](#), and [Sanchez et al., 2003](#)), indicating a widespread concern regarding the effects of transportation policies and practices in growing or perpetuating health disparities. Each of the research needs identified in this journal report presents an opportunity to consider health and transportation equity more broadly, reflect on the role of structural racism in transportation and in broader research practices, and design studies such that the research process and results may better engage and serve marginalized communities most likely to experience health and transportation disparities.

While many published papers in the transportation and health literature mention a few possible research areas, no other reports provide as broad an overview of transportation and health research gaps as the NCHRP Research Roadmap. One narrower research agenda focused on research areas associated with discrepancies between the published literature and a conceptual model of travel behavior and health ([van Wee 2016](#)). This journal report takes a more holistic, system-wide look at research needs, highlighting selected topics suitable for academic research, and then providing possible research approaches to address those topics.

The U.S. National Academies Transportation Research Board recently elevated its attention to transportation and health issues from

a subcommittee to a full standing committee (#AME70, <https://www.mytrb.org/OnlineDirectory/Committee/Details/5200>). The research needs described in this journal report as well as in the full research roadmap are being used to help guide the work of the new committee. With encouragement from this committee, this journal report and the full roadmap can help generate interest in transportation and health research to a broader group of investigators than those who work primarily on NCHRP funded projects.

The NCHRP Research Roadmap was published in 2019 before the COVID-19 pandemic began in early 2020. The pandemic has numerous implications for transportation, such as short and long-term changes in demand for travel by different modes, related to changes in how and where people work, shop, attend school, and seek recreational and health activities. Transportation agencies have responded to the pandemic by reevaluating their budgets and traveler needs; in some places they have modified public transit services and repurposed roadway space to expand access for active and healthy forms of travel (Combs 2020a, 2020b). Numerous new research questions are now arising related to how these changes may impact public health in the short and long term (<http://www.trb.org/Main/Blurbs/181423.aspx>).

Several limitations should be considered when using this journal report to consider possible research projects. The full list of 122 research needs in the Research Roadmap (NASEM 2019), and the supporting technical report, contains many more identified research gaps and background resources and should be reviewed by those considering research opportunities. The selection of the 20 topics presented here was done independently by three authors who have expertise in transportation and public health; other experts may have selected different topics to highlight. For many of the questions listed, additional work may be needed to narrow its scope and conduct a more focused literature search for use in a feasible and potentially fundable research proposal. The suggested research approach listed for each question is only one of several possible approaches. The Research Roadmap will become out of date as some research questions are answered and new questions arise; it would be valuable if the Roadmap could be updated periodically. Some of the selected topics could be investigated by a graduate student as a thesis project with minimal resources; others may need a larger research team and more resources. Finally, the NCHRP Research Roadmap focuses on transportation issues in the United States; some of its content may be less relevant to other countries.

In conclusion, this journal report presents a variety of useful research ideas that may help move the field forward and inspire the next generation of transportation and public health researchers and leaders. Answers to the research questions posed may help raise the visibility of the health and equity impacts of transportation and help guide transportation policy choices favorable to health.

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## Author statement

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## Declaration of competing interest

The authors have no financial conflicts of interest to disclose.

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