

Ger J Exerc Sport Res 2024 · 54:116–120  
<https://doi.org/10.1007/s12662-023-00936-0>  
 Received: 1 September 2023  
 Accepted: 13 December 2023  
 Published online: 12 January 2024  
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## Active mobility—(also) a topic for sport science?

Sport science is an interdisciplinary science focusing on challenges and phenomena surrounding sports, exercise, physical activity, and play. Thus, sport science renders a multi-perspective view on a great variety of forms of human movement. The interdisciplinary nature of sport science includes sub-disciplines such as sport pedagogy, sport philosophy, sport psychology, sport medicine, training science, biomechanics, human movement science, and others. While the development of the academic discipline *sport science* in Germany has been closely related to and arose from the organized sport sector, today we can observe a strong differentiation of manifold and diverse research topics ranging from rather traditionally oriented topics on competitive sports to more recent topics. These include a large and growing variety of physical and sports activities as well as exercises (e.g., leisure sport activities, activities of daily living, and active play behaviors). This wide variety of research topics in sport science also manifests in a large differentiation of departments and institutes (e.g., Institute of Sport Sciences at the universities of Hannover and Tübingen vs. Institute of Human Movement Science at the University of Hamburg), established professorships (e.g., Professorship in Sport Psychology, Professorship in Physical Activity and Public Health), and study programs in Germany (e.g., Physical Education Teaching Programs, Bachelor of “Sport Science,” Bachelor Program in Sports Science with the profile “Media and Communication,” Master’s Program in “Physical Activity and Health”). For more than two decades, a conflict flared

up between different circles of the German sport science community regarding the title *Sportwissenschaft* (sport science) and the potential renaming as *Bewegungswissenschaft* (human movement science; Rütten, 2017; Zschorlich, 2000). Furthermore, the discussion often arises on which research topics should be included in the research agenda of sport science and which not (Krüger, 2022).

Given these developments, active mobility is one domain of physical activity that has attracted increasing attention in the national and international debate including academic, societal, and political discussions. In the present discussion paper, we aim to demonstrate the relevance of active mobility research as a topic of sport science. Additionally, we want to highlight the significance of contributions from the perspective of sport science to the research and promotion of active mobility. Furthermore, we present previous contributions to active mobility research from the German sports science community, with an emphasis on research gaps, and propose perspectives of active mobility research for the German sport science community.

### What is active mobility?

Active mobility relates to physical activity that is undertaken to travel from one point to another in order to reach a destination. It includes all forms of human-powered travel behavior such as walking and bicycling as well as the use of other non-motorized vehicles that are fully or mainly powered by muscle activity (Cook, Stevenson, Aldred, Kendall, & Cohen, 2022). In international re-

search the use of public transport is often also considered as active mobility as it involves some walking or cycling to and from pick-up and drop-off points (Cook et al., 2022). The most common modes of active mobility are walking and cycling; however, pedal scooters, skateboards, impellers, hand-operated wheelchairs, or hand-bikes for traveling to a destination are also considered as active transport modes. In the international literature, a distinction is made between walking/cycling for transportation or for recreation purposes (Giles-Corti, Timperio, Bull, & Pikora, 2005). Consequently, actively traveled trips count as active transport activities whereas walking or cycling tours during leisure (e.g., family excursions, going for a walk, dog walking) do not (Spinney, Millward, & Scott, 2012). Different synonyms of active mobility such as *active travel*, *active transport*, and *active commuting*<sup>1</sup> are used almost interchangeably. However, commonly accepted definitions of these terms are still missing. The synonyms have slight differences in origin and different nuances, for example, with regard to commuting and non-commuting active travel (Sahlqvist, Song, & Ogilvie, 2012) or with regard to whether the term covers journeys without destinations (Cook et al., 2022).

Internationally, the research field of active mobility has generated a high level of interest in a variety of research disciplines (e.g., transportation research

<sup>1</sup> In the German literature there are also some synonyms that are *aktive Mobilität*, *aktiver Transport* and with regards to active commuting to school *aktiver Schulweg*.

and health geography). The first research activities on active mobility from the discipline of sport science, and especially from sport medicine, date back to the early 1990s aiming to capture the potential of active mobility on health (Oja et al., 1991; Vuori, Oja, & Paronen, 1994). Currently, research on active mobility has gained momentum with several interdisciplinary research groups focusing on this topic and exploring determinants, outcomes, and trends on the population level as well as measuring methods of active mobility including the development, implementation, and evaluation of intervention programs (Clark & Stigell, 2017; Denstel et al., 2015; Palma, Chillón, Rodríguez-Rodríguez, Barranco-Ruiz, & Huertas-Delgado, 2020; Tittlbach, Brockfeld, Kindig, & Herfet, 2023). The increased importance of active mobility can also be seen in the establishment of a Professorship in Active Mobility at the Institute of Sport Science at the University of Innsbruck in Austria ([www.uibk.ac.at/de/isw/forschung/act-mob/](http://www.uibk.ac.at/de/isw/forschung/act-mob/)) as well as the set-up of several professional organizations (e.g., CIVITAS [[www.civitas.eu](http://www.civitas.eu)]; Active Travel England [[www.gov.uk/government/organisations/active-travel-england](http://www.gov.uk/government/organisations/active-travel-england)]) and conferences (e.g., Active Transport Mobility Summit; Congress of Active Mobility).

### What research on active mobility from a sport science perspective exists in Germany?

In Germany, in the past few years, sport scientific research on active mobility has emerged in particular originating from health-related sub-disciplines and contributions from sport pedagogy. Specifically, several current studies exist that monitor active mobility in the population or in specific sub-groups such as children and adolescents. Particularly worth mentioning are the German nationwide data on active mobility in children and adolescents from the Motoric Module Study (Reimers, Jekauc, Peterhans, Wagner, & Woll, 2013; Reimers et al., 2021b), the Health Behavior in School-Aged Children (HBSC) Survey examining school-aged children (Brindley

et al., 2023), and the ARRIVE Study examining active mobility to four different destinations in adolescents (Reimers et al., 2022; Seemüller et al., 2023). For the adult population, there are nationwide representative data on transport-related walking and cycling from the GEDA Study (Finger et al., 2019) and a study from Tübingen (Teuber & Sudeck, 2021). Additionally, there are two national representative mobility surveys (*Deutsche Mobilitätspanel* [MOP; German Mobility Panel] and *Mobilität in Deutschland* Survey [MiD; Mobility in Germany]) that have also been used for data analysis from a sport science perspective (Buehler, Kuhnimhof, Bauman, & Eisenmann, 2019; Buehler, Pucher, Merom, & Bauman, 2011). Overall, the data received from these studies indicate that in Germany the prevalence of active mobility is relatively high in children and adolescents compared to other (especially non-European) countries (Marzi et al., 2023; Reimers et al., 2021a). Furthermore, it became clear that in Germany 42% of men and 39% of women aged 18 years and older comply with the physical activity recommendations of the World Health Organization (WHO, 2010) solely based on their habitual active mobility behavior (Finger et al., 2019). Similar findings were confirmed by Buehler et al. (2019), who analyzed the MOP data.

Furthermore, several studies have addressed active commuting to (and from) school by children and adolescents (Brettschneider, 2005; Grize, Bringolf-Isler, Martin, & Braun-Fahrlander, 2010; Kehne, 2011; Landsberg et al., 2008; Reimers, Engels, Marzi, Steinvord, & Krieger, 2020; Reimers et al., 2013; Reimers et al., 2021b; Schönbach, Brindley, Reimers, Marques, & Demetriou, 2020; Schönbach, Chillon, Marques, Peralta, & Demetriou, 2021; Seemüller et al., 2023). Only a few German studies from the perspective of sport pedagogy focus on the potential benefits of active mobility on child development such as social competence and competencies in traffic behavior (Kehne, 2011), diverse physical and social environmental experiences, and the development of societal participation and capabilities

(e.g., “walking school bus” as a measure to simultaneously promote active commuting and social interaction between children; Brettschneider, 2005; Egger & Hummel, 2016).

Closely related to this field of research are the concepts of walkability (Bucksch & Schneider, 2014), bikeability, and moveability (Buck et al., 2015), which were internationally developed and are also used and further studied in Germany. These concepts refer to the extent to which an area, neighborhood, or community enables or promotes walking, cycling, or other active modes of locomotion. A large body of research emphasizes the positive relationships between the walkability of the neighborhood environment and the active mobility behavior in children and adolescents (Buck et al., 2019) and in adults (Reyer, Fina, Siedentop, & Schlicht, 2014).

### What can be the future contribution of sport science to the research field of active mobility to tackle current societal challenges?

Active mobility is related to a large variety of health benefits that strongly outweigh the deleterious effects of traffic incidents and air pollution exposure (Mueller et al., 2015). Evidence for beneficial effects of active mobility have been shown on exercise capacity, maximal power, blood pressure, lipid parameters, and waist circumference (Schäfer et al., 2020), a lower risk of developing type 2 diabetes (Brinks, Hoyer, Kuss, & Rathmann, 2015), and positive effects on mental health (Herman & Larouche, 2021; Knott, Panter, Foley, & Ogilvie, 2018). Even the use of pedelecs (bicycles that provide electric assistance only when the rider is pedaling) improves cardiovascular health and fitness (Peterman, Morris, Kram, & Byrnes, 2016).

Furthermore, active mobility is highly relevant in terms of addressing the climate crisis. It is associated with reduced CO<sub>2</sub> emissions. Daily mobility-related life cycle CO<sub>2</sub> emissions are 3.2 kg CO<sub>2</sub> per person, with car travel contributing 70% and cycling 1%. Thus, cyclists

have 84% lower life cycle CO<sub>2</sub> emissions than non-cyclists and an average person who shifts travel modes from car to bike decreases life cycle CO<sub>2</sub> emissions by 3.2 kgCO<sub>2</sub> per day (Brand et al., 2021). Since for distances between 2.5 and 5 km, the majority of trips are traveled by car (Verkehrsclub Österreich (VCÖ), 2019), active mobility, especially in these cases, can be a meaningful and feasible alternative.

In addition, using active travel modes contributes to reduced traffic burden in everyday trips as well as in trips taken during vacation and increased availability of space in cities. For example, improvements to a cycle lane in Copenhagen saw a 45% drop in car traffic along that corridor (Köhler, 2017). Additionally, reducing congestion is a key method for cities to improve their economic performance. Many cities in the developing world see millions of funds lost annually to high levels of traffic congestion. For example, developing countries in Asia lose 2–5% of their annual gross domestic product to congestion (UN-Habitat, 2013).

From a sports science perspective, active mobility has the potential to make a significant contribution in reaching the minimum level of physical activity that is required to promote and maintain health and well-being (Buehler et al., 2019; Finger et al., 2019; Teuber & Sudeck, 2021). When using the internationally established system of four domains of physical activity including *occupational physical activity*, *domestic physical activity*, *active transportation*, and *leisure-time physical activity* (Sallis et al., 2006), it becomes evident that with specific research in the domain of active mobility we can contribute to the identification of key determinants and predictors as well as specific health outcomes associated with this domain of physical activity that might differ to the other core domains. Thus, in the future, further comprehensive research from a *physical activity promotion perspective* is needed to differentiate between different domains of physical activity behavior, to develop and improve measures to specifically capture active mobility, to identify social inequalities in active mobility, and to develop and evaluate interventions promoting active mobility as

one option to reach the recommended level of physical activity. Based on a *sport psychological perspective*, a special focus on defining behavior change techniques, the content of active mobility programs, as well as effects of active mobility on psychological determinants and mental health is needed. From a *sport educational perspective*, the development, implementation, and evaluation of school-specific concepts as well as workplace health promotion programs will be crucial to promote active mobility in students, teachers, parents, and working people. Furthermore, a focus must be given to educational and learning theories to include active mobility in the school curricula and workplace concepts as a door opener for social participation and the prevention of social inequalities. In addition, educational concepts for promoting safety measures such as competencies in traffic behavior as well as the use of bicycle helmets are needed. From a *nature sport science perspective*, a special focus must be given to physical preconditions as well as motor skills required to safely use active forms of transportation. In addition, training concepts must be developed for different age groups ranging over the lifespan to guarantee the safe use of equipment such as e-bikes in older adults. A further example of the importance of the sport scientific research contribution to active mobility is from a *sport equipment and sport material perspective*. In this case, the further development of e-bikes to improve the safety of elderly users as well as the improvement of bicycle helmets to prevent severe head injuries are needed in the research agenda of sport science. Finally, sport medicine could further contribute to the physiological determinants and health outcomes of different forms of active mobility.

To focus on all these different aspects and to address different research problems in these diverse areas, interdisciplinary approaches are necessary and promising. Sport science as an interdisciplinary discipline with a cross-sectional nature has the potential to contribute to the field by taking a holistic and broad perspective incorporating multiple facets of active mobility. Thus, the contribu-

tion of sport science in active mobility research is an important concern.

## Conclusion

Active mobility is a highly relevant hot topic of current research due to various societal and scientific challenges such as climate change, increasing prevalence of non-communicable diseases, and rapid urbanization processes. Sport science with its broad range of diverse sub-disciplines has the potential to contribute to these currently prevailing challenges and provide novel approaches and solutions, especially in the interdisciplinary collaboration with other associated disciplines such as public health, transportation research, or tourism and economics. Although in Germany the research field of active mobility is gaining more interest in sport science with several research groups, especially from a health-oriented sport science research perspective, in interdisciplinary approaches of active mobility research, the perspective of sport sciences is often neglected. Internationally, current discussions place the topic of active mobility primarily on a public health agenda in collaboration with transport and urban planning without considering the contribution of sport science expertise (Koszowski et al., 2019). In future, to find solutions to persisting active mobility challenges and open questions, interdisciplinary and international research including key partners from sport science is needed to generate an in-depth understanding of physical, social, environmental, and psychological aspects of active mobility. Additionally, we call on the sport science community to acknowledge, to emphasize, and to promote research on the topic of active mobility as one topic of the canon of sport science that is relevant from a scientific, societal, and political perspective.

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**Funding.** Open Access funding enabled and organized by Projekt DEAL.

**Conflict of interest.** A.K. Reimers and Y. Demetriou declare that they have no competing interests.

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