

Ger J Exerc Sport Res 2024 · 54:135–144
<https://doi.org/10.1007/s12662-023-00923-5>
 Received: 21 December 2022
 Accepted: 8 November 2023
 Published online: 13 December 2023
 © The Author(s) 2023



Selina Seemüller¹ · Franziska Beck¹ · Clara Tristram¹ · Isabel Marzi¹ ·
 Denise Renninger² · Yolanda Demetriou³ · Anne Kerstin Reimers¹

¹ Department of Sport Science and Sport, Friedrich-Alexander-Universität Erlangen-Nürnberg, Erlangen, Germany

² Department of Sport and Health Sciences, Technical University of Munich, Munich, Germany

³ Department of Sport Science, University of Innsbruck, Innsbruck, Austria

The role of parental environmental self-identity in active travel behavior within parent–adolescent dyads

Introduction

Sport science as an interdisciplinary field focuses on people's health and represents much more than pure sports performance in the sense of *citius, altius, fortius*, Latin for “faster, higher, stronger” (Owen et al. 2000; Rütten, 2017). Including the German population, health-related issues and a healthy lifestyle are gaining increasing importance (Rütten, 2017). Therefore, it is important for sports and exercise science to pay attention to health-related topics in order to keep up with this development. Physical activity (PA) has received great attention in the field of health promotion and prevention (WHO, 2019). Daily PA, as part of health science, is especially significant for children and adolescents (Poitras et al., 2016). The positive long-term effects of PA are well documented and lead to an increase in physical fitness which manifests as improved cardiovascular and metabolic health (Ekelund et al., 2012; Poitras et al., 2016). Additionally, PA is associated with better mental health in children and adolescents (Biddle & Asare, 2011; Rodriguez-Ayllon et al., 2019). In Germany, only about one third of children and adolescents

achieve the World Health Organization's recommendation of 60 min of moderate to vigorous PA per day (Burchartz et al., 2021). Daily lack of PA is associated with an increased risk for several diseases, such as diabetes and heart diseases (Larouche et al., 2014). For these reasons, it is highly important to increase PA in children and adolescents in Germany.

Active travel is one way to increase PA and is defined as using active travel modes (e.g., walking or cycling) for commuting to and from various nearby destinations in daily life (Chillon et al., 2010; Loprinzi et al. 2012). Current studies indicate that active travel also has a positive impact on health. It is associated with beneficial health effects such as reduced obesity, better cardiorespiratory fitness, and bone health (Saunders et al., 2013). For example, adolescents who cycle to school instead of using motorized travel modes can reduce their body mass index (BMI) and blood pressure (Østergaard et al., 2012; Xu et al., 2013). Furthermore, these adolescents are more likely to meet PA recommendations (Bull et al., 2020). Beside these positive outcomes for health, active travel is conducive to the development of motor skills and physical fitness in children and adolescents (Henriques-Neto et al., 2020; Stodden et al., 2008; Zeuwts et al., 2020).

Moreover, using active travel modes further has a positive impact on the environment due to the low CO₂ emissions

of these modes (Lingli, 2015). In Germany, 30% of the available energy is used for transportation, which causes tons of CO₂ emissions every year (Arnhold et al., 2016). Since climate change is one of the biggest challenges of our time, it seems reasonable to shift from using passive travel modes (e.g., car, motorcycle) to active ones. This change can lead to a reduction in CO₂ emissions, which contributes to the desired goal of “climate neutrality.” This goal aims to reduce CO₂ emissions to a minimum of 50% by 2030 within the worldwide transport sector (Buberger et al., 2022; Giles-Corti et al., 2010; Kemp et al., 2022). Furthermore, a change from passive to active travel modes would go along with significant lifecycle carbon emission benefits as well as a reduction in CO₂ emissions, having a positive impact on climatic conditions (Brand et al., 2021; Rissel Chris, 2009). Currently, there is little movement in many big cities towards sustainable mobility through the expansion of active travel modes (Cieśła & Macioszek, 2022). Therefore, there is a need to increase the implementation of active travel modes, especially in cities.

Notably, adolescents are interested in topics related to environmental protection (Crandon et al., 2022). Through active travel, adolescents not only aim to protect the environment but also to establish routines (e.g., riding the bike daily) in their everyday lives. These routines con-

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

tribute to an active lifestyle that can be maintained into adulthood (Kahlmeier et al., 2017). In the last few years, the number of adolescents preferring active travel over passive travel modes in order to protect the environment has been increasing (Frändberg & Vilhelmson, 2014; Saricam et al., 2011). Many identify themselves as being responsible for the environment and attach great importance to climate-friendly behavior which includes using active travel modes (Kuthe et al., 2019). In contrast to this, a recent study indicates that environmental self-identity is not directly linked to travel behavior in general (Zavareh et al., 2020). However, it should be noted that this study investigated the association between the environmental awareness of students and their travel behavior but considered only trips to university. Other destinations in daily life, such as shopping facilities or visiting friends, were not considered. It is important that adolescents are aware of their actions and the associated effects, including with regard to the environment.

This “extent to which someone considers oneself as a person whose actions are environmentally friendly” (van der Werff et al., 2013) is defined as environmental self-identity. It refers to a mixture of relevant outcomes, such as if a person identifies as being environmentally friendly because of riding a bicycle (Balundé et al., 2019). Further, when looking at psychological models, it is not surprising that adolescents with high environmental self-identity prefer active travel. In general, these models show that people with high environmental awareness are more likely to use active travel modes (Hellbrück & Kals, 2012). Further, the people one associates with can have a strong influence on how one develops and internalizes environmental awareness. This is a crucial important factor in the implementation and internalization of environmentally friendly behavior (Koger & Scott, 2007).

Children and adolescents are both controlled and supported by their parents. Thus, this includes internalized concepts of health and wellbeing that in turn foster specific values and self-perceptions of competences (Campbell,

2003; Horn & Horn, 2007; Schnabel, 2001). Seventy percent of adolescents who participated in a recent study stated that their social relationship with their parents shaped their environmental self-identity (Miao & Cagle, 2020). In this context, Niermann et al. (2018) developed the LIFES framework (levels of interacting family environmental subsystems), which is based on several theoretical approaches with different influencing factors that promote or hinder health-related behavior such as active travel. These factors are typically defined on different levels of influence on individual health-related behaviors (i.e., intrapersonal, interpersonal, organizational, community, and policy). The LIFES framework examines family influences at three levels of interaction (individual, parent–child, family) which occur within a family in three subsystems (immediate, proximal, distal). Between the different levels and systems, the framework establishes various links and reciprocal influencing criteria on the behavior of children and adolescents. The framework offers the possibility to capture family structures not only individually in the levels of interaction, but to understand the family in a holistic way. Therefore, according to LIFES, there are indirect and direct influences within a family to deal with different topics such as healthy foods or PA. Regarding the levels of interaction in family–environment-subsystems, it appears that parental health behavior, such as time spent sedentary in front of the TV, shows significant correlations with adolescents’ PA levels (Niermann et al., 2018). Using the framework, the authors investigated various associations between environmental behavior and different family actors. In summary, parents play a central role in the development of PA-related behaviors in children and adolescents and thus in their travel behavior. Furthermore, a recent study emphasizes that especially parents play a significant role regarding adolescents’ choice of travel mode (Forsberg et al., 2020). Decisions about which travel mode will be used to go to school or for visit friends are negotiated within parent–adolescent dyads (Back-

ett-Milburn & Harden, 2004; Sallis & Nader, 1998). In summary, a positive relationship between social support (e.g., through parents) and adolescents’ PA behaviors has been identified (Beets et al., 2010; Edwardson & Gorely, 2010). Thus, travel behavior in adolescents seems to be dependent not only on the individual but is also shaped in the context of parent–adolescent dyads.

By examining current literature in the fields of sport and health science, family studies, and climate change, we found no studies from Germany that focus on the association between the environmental self-identity of parents and travel behavior in parents and adolescents. Because young people are socialized and structured within their families, it is important to know the relevance of parental attitudes for young people’s health-related behaviors.

To gain further insights into this topic, the aim of the present study is to examine the environmental self-identity of the parents and, further, to investigate the association between the environmental self-identity of parents and their active travel behavior as well as active travel behavior in adolescents.

Methods

The present analysis is based on data from the ARRIVE (Active tRavel behaviorR in the famIly enVironmEnt) study, which is a mixed-method cross-sectional survey conducted in Germany. The ARRIVE study aims to generate a deeper understanding about adolescents’ active travel behavior by considering a socioecological perspective (Reimers et al., 2022). Data collection took place from June 17 to June 28, 2021, by means of computer-assisted web interviews with parents and their adolescents aged 11–15 years. The study was approved by the local ethics committee (ref. no.: 249_21B) and was in accordance with the 1964 Declaration of Helsinki. All participants provided written informed consent for study participation and were not compensated for their participation.

Data collection

The survey made use of an existing nationwide online panel (forsa.omninet), to which access was provided by Forsa (Berlin), a leading organization in public opinion polling. The panel is representative of the general German population regarding age, sex/gender¹, education, and place of residence. The recruitment to be included in the panel took place solely offline via telephone interviews. After Forsa had received the individuals' consent to be contacted for study participations, a nationwide balanced sample of mothers and fathers with at least one teenager aged 11–15 years was drawn for the present study. They then received an invitation link by e-mail leading to the questionnaire. Thus, the data of 517 parent–adolescent dyads were collected through an online questionnaire, which could be answered on mobile devices. The questionnaire was divided into one part for the parents and one part for the adolescents, which need to be completed one after the other. The survey took the parents about 20 min and the adolescents about 20 min to complete.

Measures

The quantitative survey is based on an adaptation of the “conceptual framework for the environmental determinants of active travel in children” (Panter et al., 2008). A detailed description of the framework related to the ARRIVE study can be found elsewhere (Reimers et al., 2022). The current study focuses on the travel behavior of adolescents and their parents and considers further sociodemographic factors as well as the environmental self-identity of parents.

Active travel

Each of the participants (parents and adolescents) was asked about their ordinary travel modes to reach four commonly visited destinations: friends/relatives, shopping, and leisure activities (Kyttä et al.,

¹ Sex/Gender Methods Group: Why sex and gender matter in health research synthesis. <http://methods.cochrane.org/equity/sex-andgender-analysis>.

Ger J Exerc Sport Res 2024 · 54:135–144 <https://doi.org/10.1007/s12662-023-00923-5>
© The Author(s) 2023

S. Seemüller · F. Beck · C. Tristram · I. Marzi · D. Renninger · Y. Demetriou · A. K. Reimers

The role of parental environmental self-identity in active travel behavior within parent–adolescent dyads

Abstract

Active travel in everyday life offers the opportunity to increase physical activity (PA), supports young people in their development, and is more sustainable than motorized travel. The environmental awareness of young people can be influenced by parents and can lead them to choose mainly active travel modes. Since parents can have a strong impact on the behavioral patterns of adolescents, it is important to investigate how parental decisions are linked to children's actions. The aim of the current study is to assess the relationship between parental environmental self-identity, referring to parents' own attitudes towards their environmentally friendly behavior, and active travel behavior in adolescents as well as parents' own travel behavior. The present research is based on the German ARRIVE (Active tRavel behavioR in the family enVironmEnt) study. The sample consists of 517 parent–adolescent dyads. Parents and adolescents completed an online questionnaire containing questions on their sociodemographic backgrounds and travel behavior to four different destinations, and the parents additionally answered questions

on their environmental self-identity. To identify differences in environmental self-identity between sex/gender, residential setting, and education level, a one-way analysis of variance was conducted. Binary logistic regressions were used to investigate associations between parental environmental self-identity and parental travel mode as well as their adolescents' travel mode. There were positive relationships between parental environmental self-identity and adolescents' use of active travel modes for the way to leisure activities, to school, and to friends. Odds ratios (OR) for these associations indicated low effect sizes (OR = 1.240–1.616). Among parents, all associations revealed statistical significance with low (OR for friends/relatives = 1.728) to medium (OR to shopping = 2.028) effect sizes. Our results suggest that adolescents' active travel routines seem to be related to parental attitudes.

Keywords

Physical activity · Active travel · Climate change · Environment · Adolescents

2018; Veitch et al., 2017). Additionally, participants indicated their usual mode of travel to work (parents) or to and from school (adolescents) as a fourth destination. To account for these various destinations, the mode and frequency of commuting to school questionnaire by Segura-Diaz et al. (2020) was modified. This scale was confirmed as a reliable and feasible tool in Spanish adolescents and only for the destination of school ($\kappa = 0.61–0.94$). Therefore, it is assumed but was not assessed that it is also suitable for other destinations. The questionnaire was translated into German and completed based on an existing German questionnaire on travel behavior (Eggs et al., 2018). The questions asked referred to the habitually used means of transport to different destinations (e.g., “Which means of transport do you usually use on your way to work? Please tick the mode of transport you use for the

majority of your journey”). The questions could be answered with “by foot,” “by bike,” “by e-bike,” “by car,” “by motorcycle,” “by bus,” “by train/metro,” and “other,” or “I do not travel this way.” If participants selected “other,” they were asked to specify this answer by typing in the used travel mode. A dichotomous variable for each of the destinations was built by assigning the travel mode to active (by foot, bike, and e-bike) or passive (by car, bus, train/metro, motorcycle). In addition, travel distance was assessed. Distance to school was obtained from parental questionnaires, and distance to the other destinations was investigated via adolescents' self-reports (Segura-Diaz et al., 2020). Adolescents could select between less than 500 m, between 500 m and 1 km, between 1 km and 2 km, between 2 km and 3 km, between 3 km and 5 km, and more than 5 km.

Table 1 Sociodemographic data of participants

Adolescents	Overall	Girls	Boys
<i>N</i> (%)	517	254(49.8%)	263 (50.2%)
Age, years (M; SD)	13.1 (1.3)	12.9 (1.4)	13.2 (1.3)
<i>School type</i>			
Elementary school	12 (2.3%)	8 (3.1%)	4 (1.5%)
Middle school	24 (4.6%)	11 (4.3%)	13 (4.9%)
Secondary school	99 (19.1%)	44 (17.3%)	55 (20.9%)
High school	294 (56.9%)	154 (60.6%)	140 (53.2%)
Comprehensive school	74 (14.3%)	31 (12.2%)	43 (16.3%)
Other	10 (1.9%)	5 (2.0%)	5 (1.9%)
Parents	Overall	Mothers	Fathers
<i>N</i> (%)	517	258 (49.9%)	259 (50.1%)
Age, years (M; SD)	47.7 (5.3)	46.2 (4.9)	49.1 (5.3)
<i>Socioeconomic status (educational level)</i>			
School not finished/student	3 (0.6%)	0	3 (1.2%)
Middle school degree	112 (21.7%)	61 (23.6%)	51 (19.7%)
Qualified secondary school degree	42 (8.1%)	15 (5.8%)	27 (10.4%)
Technical high school degree	88 (17.0%)	42 (16.3%)	46 (17.8%)
High school degree	266 (51.5%)	137 (53.1%)	129 (49.8%)
<i>Residential area</i>			
City > 100,000 inhabitants	154 (29.2%)	76 (29.5%)	75 (28.9%)
Medium-sized town 20,000–100,000 inhabitants	90 (17.4%)	44 (17.1%)	46 (17.8%)
Small town 5000–20,000 inhabitants	115 (22.2%)	56 (21.7%)	59 (22.8%)
Rural area/village	159 (30.8%)	80 (31.0%)	79 (30.5%)

M mean, *SD* standard deviation

Environmental self-identity

Parents were surveyed regarding their environmental self-identity in relation to their choice of transport. The questionnaire items were based on previous work from Zavareh et al. (2020). Their scale was confirmed as a reliable and feasible tool ($\kappa = 0.56\text{--}0.87$). Participants were requested to answer three questions on a five-point Likert scale (0 = do not agree at all to 5 = agree completely). They were asked whether choosing an environmentally friendly travel mode is an important part of who they are, whether they identify as the type of person who chooses environmentally friendly modes of transport, and whether they see themselves as an environmentally friendly person when they choose a specific mode of transport. An environmental self-identity mean score was built that represents the mean value of the three questions for each person (Cronbach's $\alpha = 0.932$).

All statistical tests were conducted using IBM SPSS 26 (IBM Corporation, Armonk, NY, USA) after having examined whether all assumptions for

statistical tests were met. Descriptive statistics were calculated for included study variables, with mean (M) and standard deviations (SD) for continuous variables and frequency (%) for categorical variables. To identify differences in the environmental self-identity between sex/gender, residential setting, and education level, a one-way analysis of variance (ANOVA) was conducted, and Bonferroni post hoc analysis was performed if the results were related to statistical significance (Beasley & Schumacker, 1995). Effect size for ANOVA was based on eta squared, with interpretation based on Cohen's *d* (no/very small effect $\rightarrow d = 0\text{--}0.02$; small effect $\rightarrow d = 0.2\text{--}0.5$; medium effect size $\rightarrow d = 0.5\text{--}0.8$; strong effect $\rightarrow d > 0.8$) (Cohen, 1988). To investigate associations between parental environmental self-identity and the travel modes of the parents as well as their adolescents' travel mode, nine binary logistic regressions were conducted separately for each destination (to and from school/to work, to friends/relatives, to shopping, and

to leisure activities). The first investigated the association between parental environmental self-identity and parental active travel behavior. The second model assessed the association between parental environmental self-identity and adolescents' active travel behavior. To consider potential confounders in both models, distance, age, parental educational level, and type of urbanization were included as covariates in the main analyses. Further, moderation effect of sex/gender was tested in both models. Effect size of logistic regression models is based on the odds ratio (OR), with OR = 1.5–2 indicating a small effect, OR = 3.0–3.5 indicating a medium effect, and a strong effect is indicated by an OR = 4.0–7.0 (Chen et al., 2010). The alpha level for all tests was set to $\alpha = 0.05$ to determine statistical significance.

Results

Characteristics of the study population

The study population included 517 adolescents (13.1 ± 1.3 years) and one of their parents (47.7 ± 5.3 years). Of the adolescents, 254 (49.1%) were female and 263 (50.2%) male, while 258 (49.9%) of the parents were mothers and 259 (50.1%) fathers. Most participants lived in rural areas (30.8%), and the fewest lived in medium-sized towns (17.4%). A total of 56.9% of the adolescents attended a high school and 51.5% of the parents had a high school degree (Table 1).

Travel mode

Regarding travel modes, the parents mostly used active travel modes to visit friends (42.2%). Further, most parents traveled passively (80.9%) to work. Regarding the adolescents' travel mode, they most often traveled actively to friends (72.9%). To and from school was nearly balanced, with around 50% of active travelers and around 50% passive. Overall, the prevalence of active travel was higher in the adolescents compared to the parents across all destinations. Table 2 provides an overview of the percentages of parents and adolescents

Table 2 Distance, number, and percentage of parents and adolescents whose main means of transport to respective destinations is active

Destination (km; SD)	Overall N (%)	Mothers N (%)	Fathers N (%)
To work (19.5; 16.5)	99 (19.1)	50 (19.4)	49 (18.8)
To friends (14.8; 31.7)	219 (42.2)	118 (45.7)	101 (38.8)
To shopping facilities (4.4; 4.2)	112 (21.6)	60 (23.3)	52 (20.0)
To leisure activities (9.9; 16.6)	210 (40.5)	101 (39.1)	109 (41.9)
Destination (km; SD)	Overall N (%)	Girls N (%)	Boys N (%)
To school (6.4; 5.8)	245 (47.3)	111 (43.7)	134 (51.0)
From school (6.4; 5.8)	247 (47.7)	113 (44.5)	133 (50.6)
To friends (2.5; 1.7)	374 (72.2)	17 (67.3)	203 (77.2)
To shopping facilities (2.0; 1.5)	367 (70.8)	165 (65.0)	202 (76.8)
To leisure activities (2.5; 1.6)	346 (66.8)	160 (63.0)	186 (70.7)

SD standard deviation

Table 3 Environmental self-identity of parents

	Average (M; SD)	p-value	Eta ²
Overall	2.99 (1.14)	–	–
Gender			
Fathers	2.93 (1.16)	0.200	0.003
Mothers	3.06 (1.11)		
Residential area			
City > 100,000 inhabitants	3.23 (1.21)	0.009*	0.026
Medium-sized town 20,000–100,000 inhabitants	2.89 (1.15)		
Small town 5000–20,000 inhabitants	2.86 (1.04)		
Rural area/village	2.91 (1.11)		
Socioeconomic status (education level)			
School not finished/student	2.56 (1.90)	0.074	0.019
Middle school degree	2.89 (1.15)		
Qualified secondary school degree	2.87 (1.14)		
Technical high school degree	2.93 (1.07)		
High school degree	3.11 (1.15)		

M mean, SD standard deviation

*p-value < 0.05

regularly traveling actively to the four destinations.

Environmental self-identity

Detailed results are provided in **Table 3**. On average, parents' environmental self-identity was 2.99 (1.14), with non-significant ($p = 0.733$) differences between mothers (3.06 ± 1.11) and fathers (2.93 ± 1.16). Participants living in cities had an average score of 3.61 (1.33), while participants living in small towns had the lowest values in their environmental self-identity (2.86 ± 1.04). Differences between various types of residential area reached statistical significance ($p = 0.009$, $\eta^2 = 0.026$), without following a gradi-

ent. The highest values (3.23 ± 1.21) were in cities, followed by rural areas/villages (2.91 ± 1.11).

However, these differences cannot be specifically assigned to any groups, as the Bonferroni post hoc analysis revealed no significant differences. Lastly, there were no significant differences concerning environmental self-identity regarding parental education level ($p = 0.487$). Parents with a high school degree reached the highest levels (3.11 ± 1.15), followed by technical high school degree and middle school degree. Having no degree is associated with the lowest environmental self-identity (2.56 ± 1.90).

Binary logistic regressions

We conducted binary logistic regression models to assess associations between parental environmental self-identity and parents' active travel behavior (**Table 4**). Across all destinations, higher parental environmental self-identity revealed a higher likelihood for active travel in parents ($p < 0.001$). The greatest OR was found for travel mode to shopping opportunities (OR = 2.082), indicating a medium effect size, while the lowest OR was found for active travel to friends/relatives (OR = 1.728), indicating a small effect size. For none of the destinations was a moderation effect of sex/gender found.

Table 5 presents the associations between parental environmental self-identity and adolescents' active travel to the four destinations. For travel behavior to school ($p < 0.026$), to friends/relatives ($p < 0.001$), and to leisure activities ($p < 0.001$), adolescents were more likely to travel actively when their parents reported higher environmental self-identity. Overall, effect sizes based on the OR were small. The significant associations were not moderated by sex/gender of the adolescents. The association between parental environmental self-identity and adolescents' active travel behavior from school and to shopping facilities did not reach significance.

Discussion

The aim of the present study is to investigate the association between the environmental self-identity of parents and their active travel behavior as well as their adolescents' active travel behavior. The present study showed statistically significant differences regarding the residential area and environmental self-identity of the parents. Regarding the logistic regression for the associations between parental environmental self-identity and parental use of active travel modes among all destinations (to work, friends/relatives, shopping facilities, and leisure activities), the current study revealed positive associations. Additionally, the logistic regressions for adolescents showed positive associations

Table 4 Associations between parental environmental self-identity (predictor) and parental active travel (dependent variable) to various destinations (to work, to friends/relatives, to shopping, to leisure activities), controlled for distance to each destination

	Regression coefficient β	Odds ratio	95% CI	p-value
<i>Active travel to work</i>				
Environmental self-identity	0.659	1.933	1.476–2.532	<0.001*
Environmental self-identity \times gender	0.299	1.348	0.795–1.286	0.267
<i>Active travel to friends/relatives</i>				
Environmental self-identity	0.547	1.728	1.397–2.137	<0.001*
Environmental self-identity \times gender	0.205	1.228	0.806–1.871	0.339
<i>Active travel to shopping</i>				
Environmental self-identity	0.734	2.082	1.635–2.652	<0.001*
Environmental self-identity \times gender	0.011	1.011	0.625–1.637	0.964
<i>Active travel to leisure activities</i>				
Environmental self-identity	0.646	1.908	1.536–2.369	<0.001*
Environmental self-identity \times gender	-0.104	0.902	0.581–1.398	0.644

CI confidence interval

*p-value < 0.05

Table 5 Associations between parental environmental self-identity (predictor) and adolescents' active travel to various destinations (to/from school, to friends/relatives, to shopping, to leisure activities; dependent variable), controlled for the distance to each destination

	Regression coefficient β	Odds ratio	95% CI	p-value
<i>Active travel to school</i>				
Environmental self-identity	0.215	1.240	1.026–1.498	0.026*
Environmental self-identity \times gender	0.067	1.069	0.733–1.559	0.728
<i>Active Travel from school</i>				
Environmental self-identity	0.134	1.143	0.939–1.393	0.184
Environmental self-identity \times gender	-0.015	0.985	0.666–1.458	0.941
<i>Active travel to friends/relatives</i>				
Environmental self-identity	0.480	1.616	1.224–2.133	<0.001*
Environmental self-identity \times gender	-0.172	0.842	0.492–1.441	0.531
<i>Active travel to shopping</i>				
Environmental self-identity	-	1.236	-	-
Environmental self-identity \times gender	0.213	1.237	0.960–1.595	0.100
Environmental self-identity \times gender	0.188	1.207	0.727–2.003	0.467
<i>Active travel to leisure activities</i>				
Environmental self-identity	0.420	1.521	1.188–1.948	<0.001*
Environmental self-identity \times gender	0.118	1.125	0.694–1.822	0.633

CI confidence interval

*p-value < 0.05

between parental environmental self-identity and the adolescents' use of active travel modes to participate in leisure activities, to school, and to meet up with friends.

The environmental self-identity of the parents did not significantly differ between mothers and fathers but showed slightly higher values for mothers compared to fathers. Existing studies also show this gender gap in environmental

self-identity, with higher scores among women (Bord & O'Connor, 1997; Li et al., 2022; Zelezny et al., 2000), and confirm this tendency.

Furthermore, even though we found no statistically significant differences in environmental self-identity in parents regarding education level, the descriptive data of the present study show a slight tendency toward higher environmental awareness among parents with a higher

education level. Existing studies confirm the assumption that these parents might be higher educated and therefore might know more about the climate crisis and the factors causing it (Ballew et al., 2020; Hamilton, 2011).

As mentioned above, environmental self-identity differs in parents only regarding the factor "residential area." However, the post hoc analysis could not assign the differences to specific groups. Nevertheless, as seen in the descriptive results, parents living in cities showed slightly higher environmental self-identity values than those living in rural areas. This could be explained by the fact that parents from cities are more often confronted with aspects related to climate change in their daily life because there is much more traffic in cities, especially cars, which produces a great deal of emissions, which contributes to high air pollution (Canadell et al., 2010; Gately et al., 2015). These parents living in cities may try to mitigate air pollution (e.g., smog) by using active and environmentally friendly travel. In addition, it may be easier for people living in cities to use active travel modes as there is often a greater supply of sharing offers (e.g., shared e-bikes or e-scooters) and more favorable infrastructure (Moser et al., 2021). Furthermore, distances within cities are often shorter, which makes it easier to actively cover them (Winkelhake, 2021). The findings suggest that parents who live in rural areas and small towns have a lower level of environmental self-identity. This could be one reason why these parents more often use passive travel modes. Additionally, mothers and fathers living in rural areas are presumably more dependent on using cars because they need to cover greater distances in everyday life. In Germany, people living in rural areas walk and cycle less and use cars more than people living in cities (Nobis & Kuhnimhof, 2018). The future urban planning of suburbs and villages should use these results in the planning of infrastructure and public transport connections. Sharing services, as they exist in cities, could be extended to rural areas.

However, it has to be mentioned that public transportation was coded as a passive transport mode in the current study. The share of public travel that was actively covered by the journey from home to the bus stop or from the bus stop to the respective destination was not surveyed separately here. However, public transportation might also be seen as an active transport mode in studies in which this type of information is surveyed (Schmidt et al., 2016). Future studies should take this into account and distinguish between active and passive time/distance within public travel.

Further, regarding the association between parental environmental self-identity and their travel behavior, our results show significant associations between environmental self-identity and parental use of active travel modes across all destinations (work, friends/relatives, shopping facilities, and leisure activities). These results are related to psychological models showing that parents with high environmental self-identity are more likely to use environmentally friendly travel modes (Hellbrück & Kals, 2012). Additionally, this can also be explained through their own motivation. People with high environmental self-identity are more likely to motivate themselves to use active travel modes by being able to translate their inner beliefs into action without needing external factors to motivate them (Weman-Josefsson & Back, 2019). Moreover, the use of active travel modes is associated with several positive outcomes, such as reduced CO₂ emissions, less air pollution, less noise, and the promotion of health (Kim & Hall, 2022; Saunders et al., 2013). Therefore, it seems reasonable that parents with high environmental self-identity care more than parents with low environmental self-identity about combating the climate crisis by reducing CO₂ emissions, and thus tend to opt for active travel modes when traveling to everyday destinations. Therefore, future research should evaluate how to increase environmental self-identity. It is important that increasingly more people become aware of their actions and their impact on the environment. Consequently, the pro-

motion of environmental self-identity is indispensable.

Parents have an impact on young people. Adolescents develop values in the course of their adolescence, which they then solidify (Balundé et al., 2020). The extent of the influence of parental attitudes on adolescents in various areas is not yet known. When looking at the associations between parental environmental self-identity and adolescents' active travel behavior, we found significant positive associations regarding travelling to leisure activities, to school, and to friends. Similarly, Forsberg et al. (2020) found that parents' self-identity with regard to the environment is associated with children's and adolescents' (travel) behavior. This finding is supported by the LIFES framework (Niermann et al., 2018), which shows that family, and thereby parents, are part of the interpersonal level and therefore have an influence on adolescents' travel mode choices; this is also evident when looking at the significant positive association between parental environmental self-identity and adolescents' travel behavior regarding leisure activities, school, and friends. In addition, a recent study confirms our findings by emphasizing that parents play a significant role in the choice of travel mode in adolescents (Forsberg et al., 2020). Furthermore, Sallis and Nader (1998) and Backett-Milburn and Harden (2004) found that decisions about travel mode regarding going to school or visiting friends are negotiated with parents. Future research projects and implications for practice must also ensure that the environmental self-identity of young people is promoted. This enables young people to make environmentally conscious decisions without the influence of their parents.

The associations found in our study are not consistent among all destinations. For example, the likelihood of adolescents' choice of active travel mode to school and to shopping facilities is not higher when parents show higher environmental self-identity. One possible explanation for this can be found in the changing relationship between young people and their parents during adoles-

cence (Ecarius, 2007). When growing up, adolescents strive for autonomy and independence from their parents (Ecarius, 2007). Therefore, it is not surprising that they try to differentiate themselves from their parents by not meeting parental expectations, including in relation to travel behavior, by, for example, not using their parents' preferred (environmentally friendly) travel modes. Regarding the non-significant association between parents' environmental self-identity and active travel to go shopping, another explanation can be derived. Shopping may result in many or heavy things to carry and thus may imply a passive travel mode to go shopping. The result is that even if the environmental attitude of the parents has already been internalized by the adolescents, this attitude is not taken into account because the circumstances restrict an active form of travel. Further, one study shows that the percentage of young people who walk home after school is higher than the percentage who travel to school actively in the morning (Herrador-Colmenero et al., 2019). This can be attributed, for example, to the fact that parents take their children on the way to work and drop them off at the school. Several studies confirm this influence of parents regarding school, as they are often not present at the close of the school day when their children are going home or to other destinations (Larsen et al., 2012; McDonald et al., 2014). Future research should take a closer look at these destinations and identify factors that lead to passive transport modes.

Strengths and limitations

The present study has some significant strengths. First, the sample of the study is representative of the general German population regarding age, sex/gender, level of education, and residential area. As most previous family studies have included predominantly mothers (Blanz, 2021; Westman et al., 2017), we included a balanced sample of mothers and fathers. In addition, and to the best of our knowledge, this is the first study to investigate the association between parental environmental self-identity and

adolescents' travel behavior. Previous studies have referred to the physical environmental factors perceived by parents (Panter et al., 2008) or analyzed the influence of the general attitudes of parents on children without explicit reference to environmental self-identities (Leslie et al., 2010). Finally, unlike previous research on active travel, this study focuses on destinations traveled to during leisure time in addition to the frequently investigated ways to and from school or work.

Beside the strengths mentioned above, the present study also has some limitations. First, the design of the study is cross sectional and, therefore, no conclusions on causality can be drawn. Subjective measures and self-reported data indicate a further limitation, since these might not be free of recall bias and social desirability. In addition, the questionnaire used in this study has been established since 2002 and is commonly used as a representative tool. Nevertheless, the psychometric properties such as validity and reliability of the questionnaire have not been tested. Further, the distance to various destinations is difficult to assess for young people. Even though the adolescents could indicate the duration of the travel, which could be easier to estimate than distance, there is a risk of misjudgment. In addition, no conclusions can be drawn with regards to mother–father interactions within families because the data were only collected from either the mother or the father. Additionally, we coded public transport passively. There are several different opinions in the current literature as to whether public transport should be coded passively or actively. In our study, we did not evaluate the proportion of actively traveled journeys to the stop of the public transport mode. Therefore, no conclusion can be drawn on how active traveling with public transport modes was. Furthermore, it should be mentioned that data collection took place during the COVID-19 pandemic. Even though there were no restrictions regarding the assessed destinations in summer 2021, we cannot preclude an impact of the pandemic on travel behavior in adolescents and their parents. Finally, the present study did not assess the en-

vironmental self-identity of adolescents, which could be useful to investigate the direct influence of adolescents' own attitudes towards active travel behavior.

Conclusion

The present study provides nationwide data on travel behavior in adolescents and parents from Germany and investigates the association between parental environmental self-identity and travel behavior in parents and adolescents. The results show high environmental self-identity scores across the included sample of parents, with the only statistically significant difference relating to the residential area of the participants. Furthermore, our results reveal that parental self-identity towards the environment has an impact on adolescents' travel behavior. Following our findings, it could be helpful to increase the level of environmental self-identity within the population in Germany. This seems to have two major positive impacts: first, with regard to mitigating climate change, and second, concerning the related health benefits due to an increase in PA. The present study captures parental environmental self-identity; future studies that aim to investigate the relationship between environmental attitudes and travel behavior should also consider environmental self-identity in adolescents. Moreover, such studies should assess environmental self-identity in more detail to obtain a deeper understanding of decisions regarding travel behavior in general. To obtain objective data, future research could make use of objective research methods and measure distances and transport behavior with tools, such as accelerometers.

Corresponding address



Selina Seemüller
Department of Sport
Science and Sport, Friedrich-
Alexander-Universität
Erlangen-Nürnberg
Erlangen, Germany
selina.seemueller@fau.de

Author Contribution. S. Seemüller: writing—review and editing, writing—original draft, methodology, conceptualization; F. Beck:

conceptualization, methodology, formal analysis, writing—original draft, writing—review and editing; C. Tristram: conceptualization, methodology, writing—original draft, writing—review and editing; I. Marzi: methodology, writing—review and editing; D. Renninger: methodology, writing—review and editing; Y. Demetriou: methodology, writing—review and editing, project administration; A. K. Reimers: conceptualization, methodology, writing—review and editing, project administration, supervision.

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

Declarations

Conflict of interest. S. Seemüller, F. Beck, C. Tristram, I. Marzi, D. Renninger, Y. Demetriou, and A. K. Reimers declare that they have no competing interests.

All procedures performed in studies involving human participants or on human tissue were in accordance with the ethical standards of the institutional and/or national research committee (ref. no.: 249_21B) and with the 1975 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study.

Open Access. This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

References

- Arnhold, O., Decker, H., Schachler, B., Fleck, M., & Goldammer, K. (2016). Energiewende im Verkehr: Welche Auswirkungen haben Batterie- und Brennstoffzellenfahrzeuge auf das Energiesystem. *gwf-Gas + Energie*, 776–780.
- Backett-Milburn, K., & Harden, J. (2004). How children and their families construct and negotiate risk. *Safety and Danger*, 11(4), 429–447. <https://doi.org/10.1177/0907568204047105>.
- Ballew, M. T., Pearson, A. R., Goldberg, M. H., Rosenthal, S. A., & Leiserowitz, A. (2020). Does socioeconomic status moderate the political divide on climate change? The roles of education, income, and individualism. *Global Environmental Change*. <https://doi.org/10.1016/j.gloenvcha.2019.102024>.
- Balundé, A., Jovarauskaitė, L., & Poškus, M. S. (2019). Exploring the relationship between connectedness with nature, environmental identity, and environmental self-identity: a systematic review and meta-analysis. *SAGE*

- Open*, 9(2), 2158244019841925. <https://doi.org/10.1177/2158244019841925>.
- Balundè, A., Perlaviciute, G., & Truskauskaitė-Kunevičienė, I. (2020). Sustainability in youth: environmental considerations in adolescence and their relationship to pro-environmental behavior. <https://doi.org/10.3389/fpsyg.2020.582920>.
- Beasley, T.M., & Schumacker, R.E. (1995). Multiple regression approach to analyzing contingency tables: post hoc and planned comparison procedures. *The Journal of Experimental Education*, 64(1), 79–93. <https://doi.org/10.1080/00220973.1995.9943797>.
- Beets, M.W., Cardinal, B.J., & Alderman, B.L. (2010). Parental social support and the physical activity-related behaviors of youth: a review. *Physical Activity and Health*, 37(5), 621–644. <https://doi.org/10.1177/1090198110363884>.
- Biddle, S.J.H., & Asare, M. (2011). Physical activity and mental health in children and adolescents: a review of reviews. *British Journal of Sports Medicine*, 45(11), 886–895. <https://doi.org/10.1136/bjports-2011-090185>.
- Blanz, M. (2021). *Forschungsmethoden und Statistik für die Soziale Arbeit: Grundlagen und Anwendungen*. Kohlhammer.
- Bord, R.J., & O'Connor, R.E. (1997). The gender gap in environmental attitudes: the case of perceived vulnerability to risk. *Social Science Quarterly*, 78(4), 830–840.
- Brand, C., Dons, E., Anaya-Boig, E., Avila-Palencia, I., Clark, A., de Nazelle, A., et al. (2021). The climate change mitigation effects of daily active travel in cities. *Transportation Research Part D: Transport and Environment*, 93, 102764. <https://doi.org/10.1016/j.trd.2021.102764>.
- Burger, J., Kersten, A., Kuder, M., Eckerle, R., Weyh, T., & Thiringer, T. (2022). Total CO₂-equivalent life-cycle emissions from commercially available passenger cars. *Renewable and Sustainable Energy Reviews*, 159, 112158. <https://doi.org/10.1016/j.rser.2022.112158>.
- Bull, F.C., Al-Ansari, S.S., Biddle, S., Borodulin, K., Buman, M.P., Cardon, G., & Willumsen, J.F. (2020). World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *British Journal of Sports Medicine*, 54(24), 1451. <https://doi.org/10.1136/bjports-2020-102955>.
- Burchartz, A., Oriwol, D., Kolb, S., Schmidt, S.C.E., Wunsch, K., Manz, K., & Woll, A. (2021). Comparison of self-reported & device-based, measured physical activity among children in Germany. *BMC Public Health*, 21(1), 1081. <https://doi.org/10.1186/s12889-021-11114-y>.
- Campbell, T.L. (2003). The effectiveness of family interventions for physical disorders. *Journal of marital and family therapy*, 29(2), 263–281. <https://doi.org/10.1111/j.1752-0606.2003.tb01204.x>.
- Canadell, J.G., Ciais, P., Dhakal, S., Dolman, H., Friedlingstein, P., Gurney, K.R., & Raupach, M.R. (2010). Interactions of the carbon cycle, human activity, and the climate system: a research portfolio. *Current Opinion in Environmental Sustainability*, 2(4), 301–311. <https://doi.org/10.1016/j.cosust.2010.08.003>.
- Chen, H., Cohen, P., & Chen, S. (2010). How big is a big odds ratio? Interpreting the magnitudes of odds ratios in epidemiological studies. *Communications in Statistics—Simulation and Computation*, 39(4), 860–864. <https://doi.org/10.1080/03610911003650383>.
- Chillon, P., Ortega, F.B., Ruiz, J.R., Veidebaum, T., Oja, L., Maeestu, J., & Sjostrom, M. (2010). Active commuting to school in children and adolescents: An opportunity to increase physical activity and fitness. *Scandinavian Journal of Public Health*, 38(8), 873–879. <https://doi.org/10.1177/1403494810384427>.
- Ciesła, M., & Macioszek, E. (2022). The perspective projects promoting sustainable mobility by active travel to school on the example of the southern Poland region. *Sustainability*, 14(16), 9962.
- Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences* (2nd edn.). Lawrence Erlbaum.
- Crandon, T.J., Scott, J.G., Charlson, F.J., & Thomas, H.J. (2022). A social-ecological perspective on climate anxiety in children and adolescents. *Nature Climate Change*, 12(2), 123–131. <https://doi.org/10.1038/s41558-021-01251-y>.
- Ecarius, J. (2007). *Handbuch Familie*. Springer.
- Edwardson, C.L., & Gorely, T. (2010). Parental influences on different types and intensities of physical activity in youth: A systematic review. *Psychology of Sport and Exercise*, 11(6), 522–535. <https://doi.org/10.1016/j.psychsport.2010.05.001>.
- Eggs, J., Follmer, R., Grschwitz, D., Nobis, C., Bäumer, M., & Pfeiffer, M. (2018). *Mobilität in Deutschland – MiD Methodenbericht*. Studie vom infas, DLV, IVT und infas 360 im Auftrag des Bundesministeriums für Verkehr und digitale Infrastruktur.
- Ekelund, U., Luan, J., Sherar, L.B., Esliger, D.W., Griew, P., Cooper, A., & International Children's Accelerometry Database Collaborators, f. t. (2012). Moderate to vigorous physical activity and sedentary time and cardiometabolic risk factors in children and adolescents. *JAMA*, 307(7), 704–712. <https://doi.org/10.1001/jama.2012.156>.
- Forsberg, H., Rutberg, S., Mikaelsson, K., & Lindqvist, A.K. (2020). It's about being the good parent: exploring attitudes and beliefs towards active school transportation. *Int J Circumpolar Health*, 79(1), 1–14. <https://doi.org/10.1080/22423982.2020.1798113>.
- Frändberg, L., & Vilhelmsen, B. (2014). Spatial, generational and gendered trends and trend-breaks in mobility. In T. Gärling, D. Ettema & M. Friman (Eds.), *Handbook of sustainable travel* (pp. 15–32). Dordrecht: Springer.
- Gately, C.K., Hutrya, L.R., & Wing, S.I. (2015). Cities, traffic, and CO₂: A multidecadal assessment of trends, drivers, and scaling relationships. *PNAS*, 112(16), 4999–5004. <https://doi.org/10.1073/pnas.1421723112>.
- Giles-Corti, B., Foster, S., Shilton, T., & Falconer, R. (2010). The co-benefits for health of investing in active transportation. *New South Wales public health bulletin*, 21(6), 122–127.
- Hamilton, L.C. (2011). Education, politics and opinions about climate change evidence for interaction effects. *Climatic Change*, 104(2), 231–242. <https://doi.org/10.1007/s10584-010-9957-8>.
- Hellbrück, J., & Kals, E. (2012). *Umweltpsychologie*. Springer.
- Henriques-Neto, D., Peralta, M., Garradas, S., Pelegrini, A., Pinto, A.A., Sánchez-Miguel, P.A., & Marques, A. (2020). Active commuting and physical fitness: a systematic review. *Physical Activity and Health*, 17(8), 2721.
- Herrador-Colmenero, M., Escabias, M., Ortega, F.B., McDonald, N.C., & Chillón, P. (2019). Mode of commuting TO and FROM school: a similar or different pattern? *Physical Activity and Health*, 11(4), 1026.
- Horn, T.S., & Horn, J.L. (2007). Family influences on children's sport and physical activity participation, behavior, and psychosocial responses. In *Handbook of sport psychology* (3rd edn., pp. 685–711). Hoboken: John Wiley & Sons.
- Kahlmeier, S., Götschi, T., Cavill, N., Castro-Fernandez, A., Brand, C., Rojas Rueda, D., Woodcock, J., Kelly, P., Lieb, C., Oja, P., Foster, C., Rutter, H., & Racioppi, F. (2017). *Health economic assessment tool (HEAT) for walking and for cycling: methods and user guide on physical activity, air pollution, injuries and carbon impact assessments*. Copenhagen: World Health Organization. Regional Office for Europe.
- Kemp, L., Xu, C., Depledge, J., Ebi, K.L., Gibbins, G., Kohler, T.A., & Lenton, T.M. (2022). Climate Endgame: Exploring catastrophic climate change scenarios. *Proceedings of the National Academy of Sciences*, 119(34), e2108146119. <https://doi.org/10.1073/pnas.2108146119>.
- Kim, M.J., & Hall, M.C. (2022). Does active transport create a win-win situation for environmental and human health? The moderating effect of leisure and tourism activity. *Journal of Hospitality and Tourism Management*, 52, 487–498. <https://doi.org/10.1016/j.jhtm.2022.08.007>.
- Koger, S.M., & Scott, B.A. (2007). Psychology and environmental sustainability: a call for integration. *Teaching of Psychology*, 34(1), 10–18.
- Kuthe, A., Keller, L., Körfggen, A., Stötter, H., Oberrauch, A., & Höferl, K.-M. (2019). How many young generations are there?—A typology of teenagers' climate change awareness in Germany and Austria. *The Journal of Environmental Education*, 50(3), 172–182.
- Kyttä, M., Oliver, M., Ikeda, E., Ahmadi, E., Omiya, I., & Laatikainen, T. (2018). Children as urbanites: mapping the affordances and behavior settings of urban environments for Finnish and Japanese children. *Children's Geographies*, 16(3), 319–332. <https://doi.org/10.1080/14733285.2018.1453923>.
- Larouche, R., Saunders, T.J., Faulkner, G., Colley, R., & Tremblay, M. (2014). Associations between active school transport and physical activity, body composition, and cardiovascular fitness: a systematic review of 68 studies. *J Phys Act Health*, 11(1), 206–227. <https://doi.org/10.1123/jpah.2011-0345>.
- Larsen, K., Gilliland, J., & Hess, P.M. (2012). Route-based analysis to capture the environmental influences on a child's mode of travel between home and school. *Annals of the Association of American Geographers*, 102(6), 1348–1365. <https://doi.org/10.1080/00045608.2011.627059>.
- Leslie, E., Kremer, P., Toumbourou, J.W., & Williams, J.W. (2010). Gender differences in personal, social and environmental influences on active travel to and from school for Australian adolescents. *Journal of Science and Medicine in Sport*, 13(6), 597–601. <https://doi.org/10.1016/j.jsams.2010.04.004>.
- Li, Y., Wang, B., & Saechang, O. (2022). Is female a more pro-environmental gender? Evidence from China. *Physical Activity and Health*, 19(13), 8002.
- Lingli, J. (2015). *Smart city, smart transportation: recommendations of the logistics platform construction*. Paper presented at the 2015 International Conference on Intelligent Transportation, Big Data and Smart City, 19–20 Dec. 2015.
- Loprinzi, P.D., Cardinal, B.J., Loprinzi, K.L., & Lee, H. (2012). Benefits and environmental determinants of physical activity in children

- and adolescents. *Obesity Facts*, 5(4), 597–610. <https://doi.org/10.1159/000342684>.
- McDonald, N. C., Steiner, R. L., Lee, C., Rhoulac Smith, T., Zhu, X., & Yang, Y. (2014). Impact of the safe routes to school program on walking and bicycling. *Journal of the American Planning Association*, 80(2), 153–167. <https://doi.org/10.1080/01944363.2014.956654>.
- Miao, R. E., & Cagle, N. L. (2020). The role of gender, race, and ethnicity in environmental identity development in undergraduate student narratives. *Environmental Education Research*, 26(2), 171–188. <https://doi.org/10.1080/13504622.2020.1717449>.
- Moser, C., Artho, J., Capillo, M., & Bibic, V. (2021). *Wirkung von Sharing-Angeboten für E-Scooter, E-Bikes und Velos auf Mobilitätsgewohnheiten und Mobilitätswerkzeuge* (p. 67). Stadt Zürich.
- Niermann, C. Y., Gerards, S. M., & Kremers, S. P. J. (2018). Conceptualizing family influences on children's energy balance-related behaviors: levels of interacting family environmental subsystems (the LIFES framework). *Health Promotion International*, 15(12), 2714.
- Nobis, C., & Kuhnimhof, T. (2018). *Mobilität in Deutschland—MiD: Ergebnisbericht*
- Owen, N., Leslie, E., Salmon, J., & Fotheringham, M. J. (2000). Environmental determinants of physical activity and sedentary behavior. *Health Promotion International*, 28(4), 153–158.
- Panther, J. R., Jones, A. P., & van Sluijs, E. M. (2008). Environmental determinants of active travel in youth: a review and framework for future research. *International Journal of Behavioral Nutrition and Physical Activity*, 5, 34. <https://doi.org/10.1186/1479-5868-5-34>.
- Poitras, V. J., Gray, C. E., Borghese, M. M., Carson, V., Chaput, J.-P., & Janssen, I. (2016). Systematic review of the relationships between objectively measured physical activity and health indicators in school-aged children and youth. *Health Promotion International*, 41(6), S197–S239.
- Reimers, A. K., Marzi, I., Beck, F., Engels, E. S., Renninger, D., Buttazzoni, A., Krieger, C., Demetriou, Y. (2022). Active travel behaviour in the family environment: protocol for the mixed-methods cross-sectional ARRIVE study. *BMJ Open*, 12(2). <https://doi.org/10.1136/bmjopen-2021-056383>
- Rissel Chris, E. (2009). Active travel: a climate change mitigation strategy with co-benefits for health. *NSW Public Health Bulletin*, 20, 10–13.
- Rodriguez-Ayllon, M., Cadenas-Sánchez, C., Estévez-López, F., Muñoz, N. E., Mora-Gonzalez, J., Migueles, J. H., & Esteban-Cornejo, I. (2019). Role of physical activity and sedentary behavior in the mental health of preschoolers, children and adolescents: a systematic review and meta-analysis. *Sports Medicine*, 49(9), 1383–1410. <https://doi.org/10.1007/s40279-019-01099-5>.
- Rütten, A. (2017). Sportwissenschaft, Bewegungsförderung und Public Health. *German Journal of Exercise and Sport Research*, 47(1), 72–81. <https://doi.org/10.1007/s12662-016-0434-z>.
- Sallis, J. F., & Nader, P. R. (1998). Family determinants of health behaviors. In D. S. Gochman (Ed.), *Health behavior: emerging research perspectives* (pp. 107–124). Boston: Springer.
- Saricam, S. Y., Kara, B., & Nurlu, E. (2011). Environmental attitude of young and adult individuals: the sample of Izmir. *Journal of Food, Agriculture & Environment*, 9(2), 658–665.
- Saunders, L. E., Green, J. M., Petticrew, M. P., Steinbach, R., & Roberts, H. J. (2013). What are the health benefits of active travel? A systematic review of trials and cohort studies. *Health Promotion International*, 8(8), e69912.
- Schmidt, S., Will, N., Henn, A., Reimers, A., & Woll, A. (2016). Der Motorik-Modul Aktivitätsfragebogen MoMo-AFB : Leitfaden zur Anwendung und Auswertung. <https://doi.org/10.5445/IR/1000062199>.
- Schnabel, P.-E. (2001). *Familie und Gesundheit. Bedingungen, Möglichkeiten und Konzepte der Gesundheitsförderung*. Weinheim: Juventa.
- Segura-Diaz, J. M., Rojas-Jimenez, A., Barranco-Ruiz, Y., Murillo-Pardo, B., Saucedo-Araujo, R. G., Aranda-Balboa, M. J., & Chillón, P. (2020). Feasibility and reliability of a questionnaire to assess the mode, frequency, distance and time of commuting to and from school: the PACO study. *International Journal of Environmental Research and Public Health*, 17(14), 5039. <https://doi.org/10.3390/ijerph17145039>.
- Stodden, D. F., Goodway, J. D., Langendorfer, S. J., Robertson, M. A., Rudisill, M. E., Garcia, C., & Garcia, L. E. (2008). A developmental perspective on the role of motor skill competence in physical activity: an emergent relationship. *Quest*, 60(2), 290–306. <https://doi.org/10.1080/00336297.2008.10483582>.
- Veitch, J., Carver, A., Salmon, J., Abbott, G., Ball, K., Crawford, D., & Timperio, A. (2017). What predicts children's active transport and independent mobility in disadvantaged neighborhoods? *Health & Place*, 44, 103–109. <https://doi.org/10.1016/j.healthplace.2017.02.003>.
- Weman Josefsson, K., & Back, J. (2019). *The value of motivational theory to influence active transport behaviors—a Swedish example*. Paper presented at the The IAFOR Conference series 2019—Independence & Interdependence, Honolulu, January 3–5, 2019.
- van der Werff, E., Steg, L., & Keizer, K. (2013). The value of environmental self-identity: The relationship between biospheric values, environmental self-identity and environmental preferences, intentions and behaviour. *Journal of Environmental Psychology*, 34, 55–63. <https://doi.org/10.1016/j.jenvp.2012.12.006>.
- Westman, J., Friman, M., & Olsson, L. E. (2017). What drives them to drive?—parents' reasons for choosing the car to take their children to school. <https://doi.org/10.3389/fpsyg.2017.01970>.
- WHO (2019). *Global action plan on physical activity 2018–2030: more active people for a healthier world*. World Health Organization.
- Winkelhake, U. (2021). „Digital Lifestyle“ – Zukünftige Mitarbeiter und Kunden. In U. Winkelhake (Ed.), *Die digitale Transformation der Automobilindustrie: Treiber – Roadmap – Praxis* (pp. 35–53). Berlin, Heidelberg: Springer.
- Xu, H., Wen, L. M., & Rissel, C. (2013). The relationships between active transport to work or school and cardiovascular health or body weight: a systematic review. *Health Promotion International*, 25(4), 298–315. <https://doi.org/10.1177/1010539513482965>.
- Zavareh, F. M., Mehdizadeh, M., & Nordfjærn, T. (2020). “If I know when you will arrive, I will let you walk to school:” The role of information technology. *Journal of Safety Research*, 72, 267–277. <https://doi.org/10.1016/j.jsr.2019.12.016>.
- Zavareh, M. F., Mehdizadeh, M., & Nordfjærn, T. (2020). Active travel as a pro-environmental behaviour: an integrated framework. *Transportation Research Part D: Transport and Environment*, 84, 102356.
- Zelezny, L. C., Chua, P.-P., & Aldrich, C. (2000). New ways of thinking about environmentalism: elaborating on gender differences in environmentalism. *Health Promotion International*, 5(3), 443–457. <https://doi.org/10.1111/0022-4537.00177>.
- Zeuwts, L. H. R. H., Deconinck, F. J. A., Vansteenkiste, P., Cardon, G., & Lenoir, M. (2020). Understanding the development of bicycling skills in children: A systematic review. *Safety Science*, 123, 104562. <https://doi.org/10.1016/j.ssci.2019.104562>.
- Østergaard, L., Grøntved, A., Borrestad, L. A. B., Froberg, K., Gravesen, M., & Andersen, L. B. (2012). Cycling to school is associated with lower BMI and lower odds of being overweight or obese in a large population-based study of Danish adolescents. *Journal of Physical Activity and Health*, 9(5), 617–625. <https://doi.org/10.1123/jpah.9.5.617>.

Publisher's Note. Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.